United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
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In Reply Refer To:
01EWFW00-2018-F-0524

Memorandum

To: State Supervisor, Washington Fish and Wildlife Office
Lacey, Washington

From: Manager, Division of Consultation and Conservation Planning
Washington Fish and Wildlife Office
Lacey, Washington

Subject: Endangered Species Act Section 7 Biological Opinion regarding the Approval of a Safe Harbor Agreement for Taylor's Checkerspot Butterfly and Issuance of a Section 10(a)(1)(A) Enhancement of Survival Permit (TE-57529C-0) to Graysmarsh LLC.

This memorandum transmits the U. S. Fish and Wildlife Service's Biological Opinion (Opinion) on the subject action pursuant to the Endangered Species Act as amended (16 U.S.C. 1531 *et seq.*) (ESA). Graysmarsh LLC (Graysmarsh) will be responsible for implementing the Safe Harbor Agreement (SHA). This Opinion analyzes the effects of issuance of the Section 10(a)(1)(A) Enhancement of Survival Permit (Permit) and implementation of the SHA. Formal consultation on the proposed action regarding effects to Taylor's checkerspot butterfly (*Euphydryas editha taylori*) (TCB) and designated critical habitat for TCB was conducted in accordance with section 7 of the ESA. This Opinion is based on information provided in the Graysmarsh SHA and other sources of information.

The Opinion concludes that the proposed issuance of the Permit to Graysmarsh is not likely to jeopardize TCB and would not destroy or adversely modify designated critical habitat for TCB. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

If you have any questions regarding the attached Biological Opinion, please contact Zach Radmer at 360-753-4325, or Carolyn Scafidi at 360-753-4068.

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Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2018-F-0524

ESA Section 10(a)(1)(A) Enhancement of Survival Permit Biological Opinion for Graysmarsh Safe Harbor Agreement

Clallam County, Washington

Federal Action Agency:

U.S. Fish and Wildlife Service
Region 1 Office
Portland, Oregon

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

E. V. Rickerson | 3/27/18

Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

Date

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
CHU	Critical Habitat Unit
ESA	Endangered Species Act of 1973, as amended (16 U.S.C. l531 *et seq.*)
ESP	Enhancement of Survival Permit
FR	Federal Register
GIS	Geographic Information System
Graysmarsh	Graysmarsh LLC
ITS	incidental take statement
Opinion	Conference Opinion
PBF	Primary Biological Features
PCE	Primary Constituent Element
Permit	Enhancement of Survival Permit
Service	U.S. Fish and Wildlife Service
SHA	Safe Harbor Agreement
TCB	Taylor's checkerspot butterfly
WDFW	Washington Department of Fish and Wildlife

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INTRODUCTION

This document represents the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) for the potential issuance of a section 10(a)(1)(A) Enhancement of Survival Permit (Permit) to Graysmarsh LLC (Graysmarsh) pursuant to the Endangered Species Act as amended (16 U.S.C. 1531 *et seq.*) (ESA). Graysmarsh will be responsible for implementing the Safe Harbor Agreement (SHA) in Clallam County, Washington. This Opinion analyzes the effects of the potential issuance of the Permit and implementation of the SHA on Taylor's checkerspot butterfly (*Euphydryas editha taylori*) (TCB) and designated critical habitat for TCB in accordance with section 7 of the ESA. This Opinion is based on information provided in the Graysmarsh SHA and other sources of information.

The Opinion concludes that the proposed Permit is not likely to jeopardize TCB and would not destroy or adversely modify designated critical habitat for TCB. A complete record of this consultation is on file at the Service's Washington Fish and Wildlife Office in Lacey, Washington.

CONSULTATION HISTORY

The population of TCB at Graysmarsh was discovered in 2006 (78 FR 61456). From 2006 forward, Graysmarsh implemented voluntary actions to maintain the condition of the habitat for the TCB population and conducted annual surveys of the adult population. On October 3, 2013, TCB was listed under the ESA as endangered and 151 acres of the Graysmarsh property were designated as critical habitat for TCB.

- On November 21, 2016, Graysmarsh and the Service held a preliminary meeting to discuss the development of a SHA.

- On December 16, 2016, the Service visited the Graysmarsh property, where the participants continued the conversation about developing a SHA.

- On February 15, 2017, Graysmarsh submitted a draft SHA to the Service.

- On March 16, 2017, the Service held a conference call with Graysmarsh to discuss the February 15, 2017, draft of the SHA. The Service returned written comments on the draft SHA on March 20, 2017.

- On April 21, 2017, the Service and Graysmarsh met to discuss the draft SHA, and in particular to determine the best way to establish the baseline for TCB at the Graysmarsh property.

- On May 23 and 24, 2017, the Service and Graysmarsh collaboratively surveyed habitat for TCB on the property to be enrolled. On June 9, the Service and Graysmarsh held a teleconference to discuss the results of the habitat survey and agree to the description of the baseline.

- On June 30, 2017, Graysmarsh submitted a second draft SHA to the Service. The Service responded with comments on that draft on July 19, 2017

- On September 11, 2017, Graysmarsh submitted their final draft SHA for TCB and requested that the Service issue a Permit pursuant to section 10(a)(1)(A) of the ESA.

- On January 4, 2018, the Service published the Notice of Availability for the SHA in the Federal Register (83 FR 533) for a 30-day comment period.

- On January 24, 2018, the Service initiated intra-Service ESA Section 7 consultation on the proposed issuance of the Permit.

- On February 19, 2018, Graysmarsh provided the final SHA to the Service and that version is the basis of this consultation.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

A federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas (50 CFR 402.02). The proposed action analyzed in this Opinion is the Service's proposed issuance of a Section 10(a)(1)(A) Permit to Graysmarsh for implementation of a SHA. The Permit would grant Graysmarsh incidental take of TCB for engaging in covered activities. Issuance of the Permit removes the section 9 take prohibition related to TCB during the permit term, subject to the limits described in the SHA and this document.

Proposed Action

The proposed action is the issuance of a ESA Section 10(a)(1)(A) Permit associated with the approval and implementation of a SHA between the Service and Graysmarsh to provide a net conservation benefit for TCB on the Graysmarsh property and regulatory certainty for the applicant. Graysmarsh prepared and submitted their application based on the Graysmarsh Safe Harbor Agreement (Graysmarsh 2017a). The proposed duration of the SHA and Permit is 50 years from the date of signature. SHAs are voluntary agreements between the Service and cooperating non-Federal landowners. Each SHA is designed to benefit federally endangered or threatened species by incentivizing landowners to implement voluntary conservation measures that are reasonably expected to provide a net conservation benefit to the species. In exchange, SHAs provide assurances to non-federal landowners interested in using their lands to benefit ESA-listed species, but who also want to avoid future restrictions on land use, in particular for ESA-listed species.

In a SHA, the landowner agrees to maintain, create, restore, or improve habitat for endangered or threatened species. The Service, working with the landowner, establishes a baseline condition for each species and determines whether the proposed actions are reasonably expected to result in a net conservation benefit (64 FR 32717). The Service's SHA policy defines the "baseline condition" as "population estimates and distribution and/or habitat characteristics and determined area of the enrolled property that sustain seasonal or permanent use by the covered species at the time the Safe Harbor Agreement is executed." SHAs also allow two categories of take (50 CFR 17.32(c)(1)(ii)): one is a result of adverse effects of management activities on covered species incidental to the enhancement of their survival, and the other is as a result of returning the lands to the established baseline at the end of the permit term. For this SHA, the baseline was measured by the vegetative characteristics of 25 meter by 25 meter "cells" likely to be occupied by TCB immediately prior to SHA implementation (Appendix B in Graysmarsh 2017a). The primary conservation measure in this proposed SHA is vegetation management in areas of TCB habitat such that those conditions are maintained at or above baseline for the benefit of the covered species during SHA implementation. The success of the net benefit provided by continued vegetation management will be determined by compliance monitoring, as described in section 4.3 of the SHA (Graysmarsh 2017a, pp. 12-13).

The Graysmarsh SHA covers 1,105 acres of private property at the edge of the Strait of Juan de Fuca just outside the town of Sequim, Washington. The property is privately owned and consists of a mix of agricultural lands (including perennial and annual crops such as berries, lavender, and barley) and other non-agricultural areas (mainly mowed grasslands, marshy areas, and large forested areas). There are 40.5 acres of habitat supporting TCB in at least one life stage, and within that area is approximately 13 acres of habitat exhibiting year-round use by TCB in all life stages. The rest of the 40.5 acres is unoccupied grass and forb stabilized sand dune (2.3 acres), emergent marsh/wetland (18.7 acres), and beach upland (6.5 acres).

The covered activities include, but are not expressly limited to agriculture, recreation, habitat maintenance (seeding, weeding, herbicide, etc.), infrastructure maintenance, management of public access, research and data collection, and road use. Covered activities are not expressly limited to these categories because "as long as Graysmarsh is in compliance with the SHA and ESP [Enhancement of Survival Permit], including its obligations of management activities and at least maintenance of the baseline conditions as described in Section 4.1, the ESP will authorize the incidental take of any TCB within the Enrolled Property" (Graysmarsh SHA 2017, p. 19). However, Graysmarsh and Service did agree to reasonably coordinate for the purpose of determining how to minimize the extent of take within the following areas: (1) selecting appropriate herbicides or insecticides for spot or broadcast application within the Established Baseline Habitat Area, and (2) performing major repairs to Access Road A. Outside of the Established Baseline Habitat Area, Graysmarsh would meet the label requirements for any insecticides used and minimize the distance that those insecticides might drift by evaluating the interaction of environmental conditions and equipment before application. The Service predicts that those efforts will be sufficient to avoid the drift of insecticides into the Established Baseline Habitat Area. The following highlights certain aspects of covered activities that will be relevant to this consultation.

<u>Maintaining and Potentially Enhancing Existing Baseline Conditions</u>

Graysmarsh would manage 13 acres of habitat for TCB (referred to as Area 1 in the SHA) to maintain and potentially enhance the existing baseline conditions described in Section 4.1.4 (Graysmarsh 2017a, pp. 9-10) (Figure 1). Management includes annual hand removal of Scotch broom (*Cytisus scoparius*). This activity will continue until Scotch broom is considered eradicated (i.e., no visible occurrence of Scotch broom within the baseline cells). Scotch broom removal will continue to be completed during the fall and winter months (approximately September to January) typically by hand to avoid or minimize effects on TCB. Upon eradication, the baseline area habitat will be monitored for new Scotch broom infestations, and those new infestations will be removed by hand. Maintenance of the existing vegetative composition described in Section 4.1.4 may also include the removal of additional species (e.g., grasses and woody vegetation) by means of herbicide application or manual removal. Cultivation of target host plants, larval food plants, or nectar plants through seeding or plugging may also occur as a method to maintain current baseline conditions or potentially enhance them. These activities would be conducted during the season most appropriate for minimizing the potential impacts on TCB and maximizing the effectiveness of the treatments.

Graysmarsh would also manage 25.2 acres of habitat for TCB (referred to as Area 2 in the SHA) to ensure that the existing vegetative composition described in Section 4.1.3 is maintained (Graysmarsh 2017a, p. 9) (Figure 1). Management includes ensuring that the seasonal marsh is maintained as a freshwater ecosystem that maintains the existing vegetative composition and continues to contribute to the heterogeneity of the surrounding upland vegetation. Graysmarsh will promptly repair any breaches to the dune to protect TCB-occupied habitat and the adjacent freshwater source. Depending on the scale of the breach, such repair may include rebuilding the levee by hand or through use of a small tractor. All work would be conducted in a manner designed to avoid and minimize impacts on TCB habitat to the extent possible.

Public Access and Road Use Management

Graysmarsh proposes to manage public access to, and use of, Areas 1 and 2 (Figure 1) to minimize the potential for direct impacts on TCB. Public access into Areas 1 and 2 is currently restricted by fencing and the existing enforcement of property rights by Graysmarsh staff. However, illegal public trespass is relatively common. While it is not feasible to eliminate illegal public trespassing from this area, Graysmarsh will continue to maintain fencing and signage indicating private property and prohibitions on trespassing and unauthorized hunting. Graysmarsh will also continue to inform the public when encountered that they are not permitted to access Areas 1 and 2 without prior permission granted by the landowner.

Private internal access in the northern part of the enrolled property is provided by Access Roads A and B and mainly consists of vehicle or foot traffic to transport equipment and staff and some occasional horse and bike use. Graysmarsh would also limit its use of Access Road A during the time when the covered species is most active and vulnerable (January 1 through September 30). During this time, use of the access road by Graysmarsh will be limited to the following activities: 1) limited trips to transport equipment to locations that cannot otherwise be accessed on an as-needed basis, 2) limited horse, bike, light vehicle (such as golf carts), and foot traffic on an as-needed basis, and 3) emergency access (e.g., to address storm damage) on an as-needed basis.

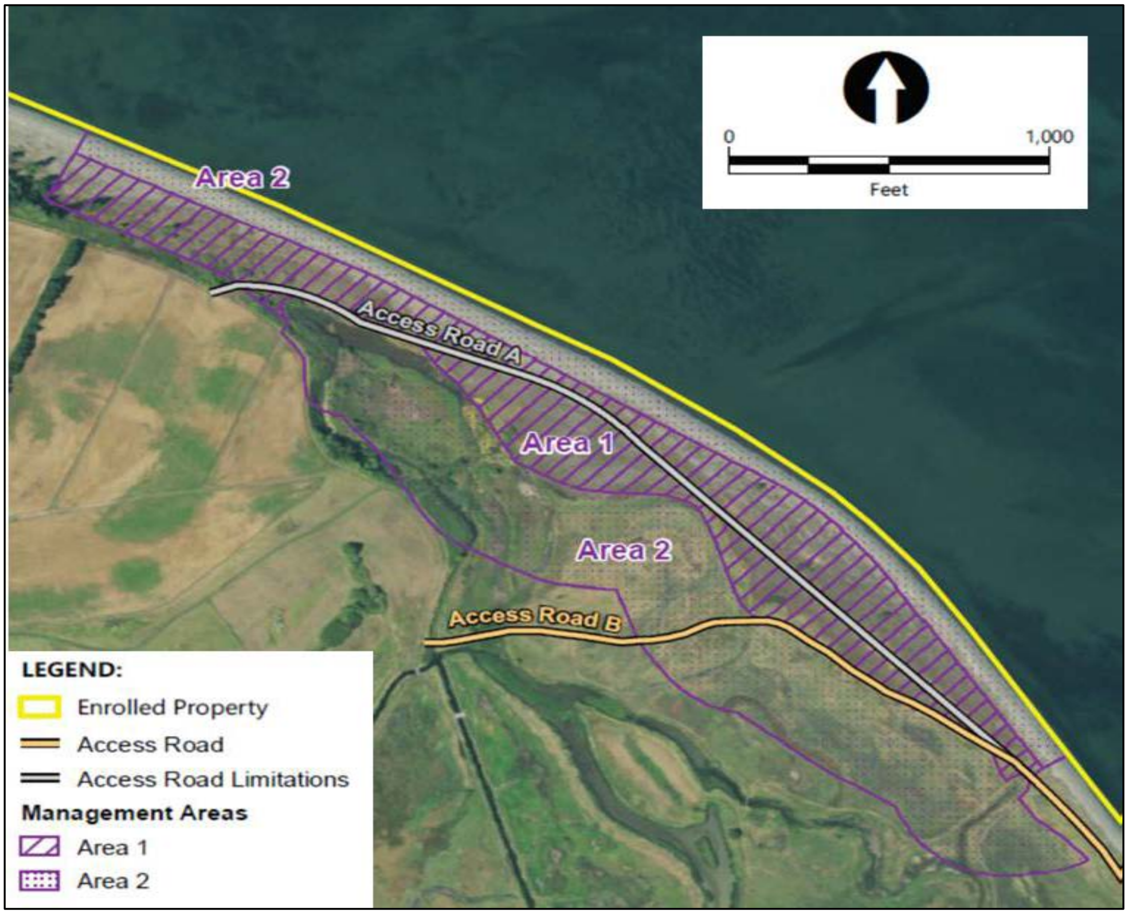

Figure 1. Map of a portion of the enrolled property, showing Areas 1 and 2 (which combined represent the established baseline) and Access Roads A and B.

Surveying, Monitoring, and Research

Graysmarsh would conduct annual surveys for adult TCB during the flight season consistent with the methods described in Appendix A of the Graysmarsh SHA. This yearly survey is expected to indirectly provide a conservation benefit to the species by providing Graysmarsh and the Service with important population information that may inform management strategies and status evaluations. The survey data will be compiled after completion of the surveys and provided to the Service by the end of each calendar year. Graysmarsh is also willing to actively consider and discuss with the Service other opportunities to advance research and data collection to promote the recovery and conservation of the covered species. Graysmarsh will work with the Service to determine the specific parameters, responsibilities, and protocols for completing additional research and/or data collection efforts that may be undertaken by the Service or qualified third parties. Graysmarsh and the Service will cooperate to determine the benefits and feasibility of each proposal.

The Service may choose translocate individuals from the TCB population at Graysmarsh to other habitats. Translocation could be a tool for establishing new populations, promoting gene flow, or rescuing the Graysmarsh population from perceived environmental threats. If translocation is warranted, the Service will approach Graysmarsh with an implementation plan and work with Graysmarsh to revise the SHA if needed. Graysmarsh need only provide access for Service personnel, and there would be no new commitments beyond those already described in the SHA.

Graysmarsh, for the purpose of assessing the condition of TCB habitat relative to the baseline established in the SHA, would need to monitor and collect data as described in Appendix B of the Graysmarsh SHA. This habitat monitoring would occur during the estimated last week of the flight season (usually late May) when most larvae are not old enough to leave their first host plant and fewer adult TCB are still active. The frequency of this monitoring would vary over time, but could occur as frequently as once a year. Graysmarsh and the Service agreed to initially monitor the baseline in years 1, 3, and 5 after the approval of the SHA and issuance of the Incidental Take Permit (Graysmarsh 2017a, B-4).

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. The action area for this action is limited to a portion of Graysmarsh property in Clallam County, Washington (Graysmarsh 2017a, Figures 1, 2, 3). The total enrolled property is 1,105 acres. Actions specified in the SHA that would provide a net conservation benefit to TCB would primarily occur within 40.5 acres.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

The following analysis relies on the following four components: (1) the *Status of the Species*, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of TCB and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

Section 7(a)(2) of the ESA requires that federal agencies insure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of “destruction or adverse modification of critical habitat” was published on February 11, 2016 (81 FR 7214). The final rule became effective on March 14, 2016. The revised definition states: “Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.”

Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical or biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations (81 FR 7414) discontinue use of the terms “PCEs” or “essential features,” and rely exclusively on use of the term “PBFs” for that purpose because that term is contained in the statute. However, the shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features. For those reasons, in this biological opinion, references to PCEs or essential features should be viewed as synonymous with PBFs. All of these terms characterize the key components of critical habitat that provide for the conservation of the listed species.

Our analysis for destruction or adverse modification of critical habitat relies on the following four components: (1) the Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat for the species in terms of essential features, PCEs, or PBFs, depending on which of these terms was relied upon in the designation, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units.

For purposes of making the destruction or adverse modification finding, the effects of the proposed federal action, together with any cumulative effects, are evaluated to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PBFs to be functionally re-established in areas of currently unsuitable but capable habitat) to serve its intended conservation/recovery role for TCB.

STATUS OF THE SPECIES

For a detailed account of TCB biology, life history, threats, demography, and conservation needs, refer to Appendix A: Status of the Species: Taylor's Checkerspot Butterfly. A summary is provided below.

The Taylor's checkerspot butterfly was listed as an endangered species on October 3, 2013, throughout the subspecies' range in Washington, Oregon, and British Columbia (78 FR 61452 [October 3, 2013]). The primary reasons for listing included the following: extensive habitat loss through conversion and degradation of habitat, particularly from agricultural and urban development; successional changes to grassland habitat; military training; the spread of invasive plants; and other factors including low genetic diversity, small or isolated populations, low reproductive success, and declining population sizes.

Habitat for TCB consists of patches of early seral, short-statured, perennial bunchgrass plant communities composed of native grass and forb species with little or no overstory forest vegetation that contain the primary larval host plants of narrow-leaved plantain (*Plantago lanceolata*) and harsh paintbrush (*Castilleja hispida*), as well as abundant flowering forbs to provide nectar sources for the adult butterflies. These habitats are associated with open prairies in the Willamette Valley – Puget Sound lowlands, as well as grassy balds and coastal bluff habitats on the north Olympic Peninsula and Gulf Islands in British Columbia. There has been a rapid decline in the spatial distribution of prairies (grassland habitat) throughout the range of TCB. Over 90 percent of the historic prairie and grassland habitat has been lost; as a result, the present distribution of TCB is disjunct and isolated throughout the subspecies' historical range. The distribution of TCB has been reduced from more than 80 populations to approximately 14 occupied locations with small populations that are known rangewide today. All sites where the TCB is extant face ongoing threats associated with forest succession, invasive nonnative plants, and other uses that degrade habitat for TCB.

Habitat for TCB requires active management to prevent the establishment of invasive, nonnative and native woody species, and restoration to establish native plant species and the structure of the plant community that is suitable for TCB, while also being protective of extant TCB populations. The recovery needs of the TCB include sufficient suitable habitat for population expansion and growth, and these sites must receive routine and sustained management to maintain the early seral conditions essential to the TCB. Reintroduction efforts using captive-rearing and translocation techniques to reestablish local populations are also necessary, because the distances and isolation of extant populations preclude the potential for natural dispersal and colonization in most areas.

In summary, the combination of several threats that have significant impacts on populations and the ongoing nature of these threats to the few remaining small populations of TCB lead us to conclude that the subspecies is currently in danger of extinction throughout its range.

STATUS OF CRITICAL HABITAT

For a detailed account of the status of the designated TCB critical habitat, refer to Appendix B: Status of Designated Critical Habitat: Taylor's Checkerspot Butterfly. A summary is provided below.

On October 3, 2013, the Service designated critical habitat for TCB under the ESA. The critical habitat designation includes three critical habitat units (CHUs) which encompass approximately 1,941 acres in Island, Clallam, and Thurston Counties in Washington; and in Benton County in Oregon (78 FR 61506-61589). The critical habitat designation within the three CHUs is further subdivided into 11 subunits. PCEs are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of TCB critical habitat consist of four components (78 FR 61576-61577): 1) patches of early seral, short-statured, perennial bunchgrass plant communities, 2) primary larval host plants, 3) adult nectar sources, and 4) aquatic features.

ENVIRONMENTAL BASELINE: TAYLOR'S CHECKERSPOT BUTTERFLY AND DESIGNATED TAYLOR'S CHECKERSPOT BUTTERFLY CRITICAL HABITAT

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Current Condition of the Species and Critical Habitat in the Action Area

<u>Condition of the Species</u>

The stabilized sand dune and access road at Graysmarsh supports one of the largest remaining populations of TCB in the range of the species. Several hundred TCB adults have been observed in a single day at this location during standardized surveys from 2006 to 2017 (Table 1). Since the population was not discovered until 2006, we do not know how long this site has been occupied, or how large or extensive the population has been over time. Records indicate that these stabilized sand dune habitats and other coastal habitats were once more abundant in Washington and supported multiple TCB populations (Hinchliff 1996, p. 115). There are approximately 40.5 acres of habitat at Graysmarsh supporting TCB in at least one life stage and, within that area, approximately 13 acres of habitat exhibiting year-round use by TCB in all life stages. The rest of the 40.5 acres is emergent marsh/wetland (18.7 acres) and beach upland (6.5

acres). Individuals are occasionally observed outside of those 40.5 acres (Chan in litt. 2017). Using Geographic Information System (GIS), we estimated that there are 342 acres available to TCB on the enrolled property without having to fly over forest.

TCB at Graysmarsh use narrow-leaved plantain as their host plant. The majority of narrow-leaved plantain on the site, and the majority of the oviposition on narrow-leaved plantain by TCB on the site, is on and immediately beside Access Road A (Severns and Grosboll 2011, p. 17) (Figure 1). There are also two other plants species present on the site that TCB eat as post-diapause larvae: blue-eyed Mary (*Collinsia parviflora*) and dwarf owl's clover (*Tryphysaria pusilla*) (Severns and Grosboll 2011, p. 8). The presence and therefore availability of blue-eyed Mary and dwarf owl's clover for TCB to eat is patchy (Graysmarsh 2017a, Figure 5 in Appendix B), and little is known about how exactly how often these plants are used by the Graysmarsh TCB population. The density and distribution of narrow-leaved plantain, especially where a larval food plant is also proximate, is likely the most important attribute of this site for supporting the TCB population.

Access Road A is a key feature of TCB habitat at Graysmarsh. The warm road surface is used by adults for basking and for oviposition where host plants occur. TCB larvae, the product of eggs deposited within crawling distance (10 meters, Kuussaari et al. 2004, p. 140) of the road during the previous season, use the road surface to increase their body temperature and feed on plants in the road or the road shoulder pre- or post- diapause. During the diapause season, larvae may choose to diapause on the road shoulders or ditches and possibly even on the road surface itself.

TCB probably nectar very infrequently at Graysmarsh. This is highly unusual for TCB populations, but not unusual for lepidopterans in general. The Washington Department of Fish and Wildlife (WDFW) has noted a few instances of nectaring, but many of those observations were at uncommon plants for the site (e.g., *Sanicula arctopoides*) or in locations away from the 13 acres where the TCB population is centered (Severns and Grosboll 2011, p. 23). Dan Grosboll, while studying TCB at Graysmarsh in 2011 for many hours a week, noted that "nectar plants are scarce" and did not report observing any TCB adults nectaring (Severns and Grosboll 2011, p. 9). We do not know if the lack of nectar is a limiting factor for TCB at this location. It is possible, but not certain, that additional nectar sources would extend the lives and improve the fecundity of adults during the flight season.

On May 23 and 24, 2017, the Service and Graysmarsh conducted a survey of the habitat conditions at Graysmarsh for the purpose of establishing "baseline conditions" (64 FR 32722) (Graysmarsh 2017a, pp. 7-10). The survey results described approximately 13 acres of upland grass and forb habitat, divided into 85 25 m^2 cells. There are 63 cells that exhibit at least 60 percent bare ground (approximately 9.7 acres), 26 cells that exhibit at least 60 percent bare ground and at least 70 narrow-leaved plantain plants and an average of 140 individual plants (approximately 4 acres), and 12 cells that exhibit at least 60 percent bare ground and moderate or common levels of blue-eyed Mary or dwarf owl's clover (approximately 1.9 acres). The total cells that meet these categories exceed 85 because cells can count towards multiple categories.

The Service understands that these characteristics describe the quality and quantity of TCB habitat at Graysmarsh, but that the larger scale setting in an open landscape is also important for the function of this habitat.

Graysmarsh, sometimes with the assistance of WDFW, has been implementing a monitoring scheme for adult TCB during the flight season each year since 2006 (Graysmarsh 2017a, Appendix A). The survey method since 2008 has been "distance sampling," where observers walk predetermined transects and record the number of TCB seen and the distance from the transect to the TCB individuals observed. In the absence of more advanced data analysis, the peak daily count can represent the relative environmental baseline of the population from year to year (Table 1). The peak daily county is the total number of adult TCB observed on the day in the season that the most adult TCB were observed. One problem with interpreting this data is that survey effort has varied since 2006, from 3 survey days to 13 survey days that met protocol (Graysmarsh 2017b, Appendix A). Recording the actual day that had the most butterflies is difficult because adults only live 4 to 15 days (Cushman et al. 1994, p. 196) and environmental conditions often do not meet protocol on the day that surveyors are available to complete the work. Adult butterflies are typically present from April 1 to June 15 at Graysmarsh, and this is referred to as the flight season. The duration and timing of the presence of adult butterflies during this period varies significantly from year to year.

Table 1. Results from distance sampling surveys during the TCB flight season at Graysmarsh, 2006 to 2017

Year of Survey	Peak Daily Count
2006	163
2007	141
2008	50
2009	242
2010	538
2011	194*
2012	221
2013	601
2014	263*
2015	463*
2016	165
2017	250

(Graysmarsh 2017b, Appendix A; Stadtmueller in litt. 2017).

*The Service received conflicting reports on peak daily counts from Graysmarsh (Graysmarsh 2017b, Appendix A) and the WDFW. WDFW had reported peak daily counts of 365 in 2011, 614 in 2014, and 754 in 2015 (Potter in litt. 2016).

Condition of the Critical Habitat

The action area includes 151 acres designated as TCB critical habitat, specifically all of CHU 2-D (78 FR 61524). The Service was able to observe the presence and condition of the PCEs in this critical habitat unit during the habitat survey conducted on May 23 and 24, 2017. All four PCEs of critical habitat are present, although PCE 3 is limited in both quantity and quality.

Critical habitat in the action area includes patches of early seral, short-statured plant communities composed of native grass and forb species with little or no overstory forest vegetation and with areas of bare soil for basking (PCE 1). The majority of PCE 1 in the action area is an approximately 13-acre stabilized sand dune that is bisected by a dirt access road. PCE 1 here is high quality: open ground cover is mostly greater than 60 percent and shrub and tree cover is mostly less than 5 percent (Graysmarsh 2017a, Figures 1 and 2 in Appendix B). However, invasive grasses are reducing open ground cover in some places and are likely to present a management challenge in the future.

Critical habitat in the action area also includes a primary larval host plant (narrow-leaved plantain) and two of the secondary annual larval host plants (PCE 2). As previously described in the environmental baseline, narrow-leaved plantain is particularly abundant on and beside the access road across the stabilized sand dune. The secondary annual larval host plants blue-eyed Mary and dwarf owl-clover are present at Graysmarsh as well, and are located close to primary larval host plants where they can support post-diapause larvae.

Adult nectar food sources (PCE 3) are present but rare in the critical habitat at Graysmarsh, and are not always in close proximity to PCEs 1 and 2. As previously described in the environmental baseline, TCB have been observed nectaring on a few occasions but it is likely that some or most TCB in the action area live their adult lives without encountering PCE 3. Surveys on May 23 and 24, 2017, recorded the presence of potential nectar plants. But, as described above, it is most likely that TCB adults in the action area do not nectar on these plants and simply breed and die without nectaring.

A portion of the designated critical habitat in the action area includes active agricultural land (to the Southwest). PCEs 1, 2, and 3 are intermittently present in this agricultural area, either incidentally (e.g., narrow-leaved plantain along roads) or purposefully (strawberry grown in planted rows). However, PCEs in the agricultural zone are less permanent than elsewhere in critical habitat because land use removes these PCEs on a yearly or more frequent basis.

Critical habitat in the action area also contains aquatic features such as wetlands, springs, seeps, streams, ponds, lakes, and puddles that provide moisture during periods of drought (PCE 4). Specifically, the action area includes a large freshwater marsh that borders habitat occupied by the TCB population. The quality of PCE 4 here is unknown, because the Service does not have data to suggest the importance of this freshwater wetland to TCB or to sustaining the other PCEs through times of drought.

Unfortunately, we do not know the historical distribution of PCEs in the action area. We presume that PCEs are not distributed in the same locations that they were historically, given the current presence of PCEs along the access road. Encroachment of woody trees and shrubs and the establishment of invasive species are the current primary threats to the condition of the critical habitat in the action area. These threats must be managed if the quality of critical habitat in the action area is to be maintained.

Conservation Role of the Action Area

The action area supports one of the largest populations of TCB in the range of the species and is the only habitat where TCB still persist in a stabilized sand dune environment. This TCB population has been on a path of divergent evolution from other TCB populations as evidenced by some unique genetic characteristics (Severns et al. 2013). Therefore, the survival of the TCB population at this location is an important condition for ensuring the conservation of the species. For this reason, critical habitat in the action area is unique from the rest of the critical habitat rangewide. Threats in the action area include the encroachment of shrubs and trees, invasion of non-native plants, and sea level rise (see *Climate Change* section below). Conservation at a population scale would require addressing all of these threats. Conservation of the species at the range-wide scale (i.e., recovery) will likely require conserving unique populations like this one that contribute to representation, resiliency, and redundancy.

Climate Change

Consistent with Service policy, our analyses under the ESA include consideration of ongoing and projected changes in climate. The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2014a, pp. 119-120). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2014a, p. 119). Various types of changes in climate can have direct or indirect effects on species and critical habitats. These effects may be positive, neutral, or negative, and they may change over time. The nature of the effect depends on the species’ life history, the magnitude and speed of climate change, and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2014b, pp. 64, 67-69, 94, 299). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change and its effects on species and their critical habitats. We focus in particular on how climate change affects the capability of species to successfully complete their life cycles, and the capability of critical habitats to support that outcome.

Climate change will continue to occur over the proposed 50-year term of the Permit, and will continue to have effects on the TCB population at Graysmarsh. Below we describe the current estimates for changes to temperature, precipitation, and sea level rise in the action area. We also describe TCB's vulnerability to these changes in the action area. The *Integration and Synthesis* section will analyze likely future effects on TCB from climate change and how the proposed Permit might ameliorate or exacerbate those effects.

Temperature and Precipitation

We used predicted climate change at the nearby Dungeness National Wildlife Refuge to estimate climate change on the enrolled property (Conservation Biology Institute 2018). The average maximum temperature is projected to exceed the historical average by 2.95 degrees Fahrenheit over the next 30 years and by 6.08 degrees Fahrenheit in the last 20 years of the proposed Permit. The average minimum temperature is projected to exceed the historical average by 3.1 degrees Fahrenheit over the next 30 years and by 6.12 degrees Fahrenheit in the last 20 years of the proposed Permit. The average precipitation is projected to fall below the historical average by 0.07 percent over the next 30 years but increase by 1.18 percent in the last 20 years of the proposed Permit; although precipitation projections vary widely among models. However, specific to the months of January, February, and March (active period of post-diapause larvae), average precipitation is projected to exceed the historical average by 10.25 percent by the end of the term of the Permit, and specific to the months of April, May, and June (flight season), average precipitation is projected to decrease from the historical average by 8.98 percent by the end of the term of the Permit.

Sea Level Rise

Mean sea level globally is rising primarily due to ocean warming (which causes expansion) and the melting of land-grounded ice. However, localized sea level rise can vary from the global mean, which makes future relative sea level heights more difficult to predict. Atmospheric pressure patterns and tectonic forces, for example, can change predicted sea level relative to land. Despite uncertainties, significant research and synthesis is available for the Olympic Peninsula and the action area (e.g., Petersen et al. 2015). Portions of the Olympic Peninsula are experiencing tectonic uplift, but the relative elevation of the action area is essentially remaining static (Petersen et al. 2015, pp. 25-26). Average sea level rise in the Strait of Juan de Fuca (relative to contemporary mean high higher water) could be as large as two feet by the end of the proposed Permit term, and is likely to be at least one foot higher (Kopp et al. 2014 *in* Petersen et al. 2015, p. 24).

Mean sea level rise, however, is not the best indicator of potential future effects of climate change on coastal ecosystems. The probability and severity of extreme tidal events is much more important because those effects extend farther inland, and it only takes one event to have large impacts on species and ecosystems not accustomed to tidal inundation. Petersen and others (2015, p. 29) estimated a 75 percent probability of annual extreme coastal flood heights above 2.3 feet relative to current mean high higher water in Port Angeles by 2050, and a 75 percent probability of annual extreme coastal flood heights above 2.6 feet relative to current mean high higher water in Port Townsend by 2050. We assume for this consultation that coastal flooding heights up to 3 feet above mean high higher water are reasonably certain to occur in the action area by 2068 (the year that the proposed permit would expire).

Vulnerability in the Action Area

Temperature and precipitation regimes will change over the term of the proposed Permit. In the *Status of the Species*, we recognized that weather events and climatic factors strongly influence the reproduction and larval survival rates for TCB, and these effects are most profound in species with small, isolated populations. Unfortunately, we do not have enough information to meaningfully evaluate the vulnerability of the population in the action area to these ongoing temperature and precipitation changes. The relationship between climate change and survival for the *Euphydryas editha* complex is driven more by the indirect effects of the interaction between seasonal growth patterns of host plants and the life cycle of the checkerspot butterfly than by the direct effects of temperature and precipitation (Guppy and Fischer 2001, p. 11; Parmesan 2007, p. 1868; Singer and Parmesan 2010, p. 3170). The trend in plant phenology in response to climate change has been an "earlier spring" (e.g., Cayan et al. 2001). The interplay between host plant distribution, larval and adult butterfly dispersal, and female choice of where to lay eggs will ultimately determine the population response to climate change (Singer and Parmesan 2010, p. 3164). The Service is still evaluating whether TCB populations, including the Graysmarsh population, will be able to adapt those changes.

TCB in the action area are extremely vulnerable to sea level rise and tidal events. The TCB population currently exists just several feet above sea level at mean high higher water. Petersen and others (2015, p. 34) created a model that predicted complete inundation of the current TCB population's habitat by 2050. Individuals are present in their habitat year round and have no known mechanism for surviving tidal inundation. Graysmarsh maintains a levee on the enrolled property, but that levee does not protect the majority of the TCB habitat on the property and we do not know how long the levee can be practically maintained. There are, however, uncertainties in the model and ways that the TCB population may continue to persist through the duration of the proposed Permit. Petersen's prediction did not take into account accretion/deposition of material in the action area. It is unlikely, but possible, that changing suitability of habitat will allow the TCB population to move to higher elevations on the enrolled property.

Critical habitat in the action area is also extremely vulnerable to sea level rise and tidal events. The highest quality critical habitat in the action area will be frequently inundated by 2050 (Peterson et al. 2015, p. 34). Wave action and increased salinity associated with sea level rise are likely to degrade or completely remove the PCEs of critical habitat. The function of critical habitat in the action area will almost certainly be reduced during the Permit term.

The Service recognizes that the TCB population at Graysmarsh may be extirpated due to tidal inundation during the term of the proposed Permit. Extirpation may occur before habitat conditions degrade (e.g., as individuals drown) or extirpation may occur as a result of habitat changes as sea levels rise. Regardless of the issuance of the proposed Permit, conservation agencies will likely consider translocating TCB individuals from this population to upslope habitats in an effort to preserve the genetic diversity present in the population. The effects of the SHA on those future possibilities are analyzed further in the *Integration and Synthesis* section.

EFFECTS OF THE ACTION: TAYLOR'S CHECKERSPOT BUTTERFLY

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The SHA describes voluntary conservation actions that are expected to lead to net conservation benefits to TCB. To issue an enhancement of survival permit under section 10(a)(1)(A) of the ESA, there needs to be a reasonable expectation of net conservation benefits that contribute directly, or indirectly, to the recovery of the covered species (64 FR 32717). In this case, the benefits are associated with the maintenance of suitable habitat conditions as described in the SHA, continued management of public access and road use limitations, and adult TCB surveys during the flight season. There will also be adverse effects associated with SHA implementation, even from actions that are otherwise beneficial. Here we evaluate the potential effects of seeding and plugging plants, manual vegetation removal, herbicide application, infrastructure maintenance, agricultural activities, annual adult surveys and intermittent baseline surveys, foot traffic, road use, and early termination of the SHA.

Seeding and Plugging Plants

Graysmarsh, pursuant to maintaining the baseline condition of the SHA, is likely to augment the diversity, abundance, and distribution of early seral plant species on the enrolled property. This may be accomplished with pre-grown plugs or with seeds. New plant species could include primary host plants, such as paintbrush (*Castilleja spp*.), secondary larval food plants, such as sea blush (*Plectritis congesta*), or nectar plants, such as footsteps of spring (*Sanicula arctopoides*). Maintenance of or improvement in the baseline condition under the SHA is the single most important ecological factor for continued survival of the population of TCB at Graysmarsh. We anticipate that the maintained or increased abundance and diversity of plants important to TCB at Graysmarsh would improve the survival of individuals and the resiliency of the population. Therefore, if these actions are taken during implementation of the SHA, it would have a significant beneficial effect on TCB in the action area. However, seeding and plugging plants is not wholly beneficial because some larvae in diapause are likely to be crushed by foot traffic during planting. The potential for crushing TCB while implementing this work will be addressed in more detail under *Foot Traffic*, below.

Manual Vegetation Removal

Graysmarsh, pursuant to maintaining the established baseline condition, is likely to remove encroaching trees and other vegetation (e.g., Scotch broom) from the enrolled property. Much of this work would occur during the fall and winter months (approximately September to January) while TCB larvae are in diapause. Encroaching trees and other vegetation would typically be removed with the use of hand tools to avoid or minimize effects on TCB. We are unable to estimate how much manual vegetation removal will occur during the 50-year term of the Permit, but it will likely be small areas (less than an acre) each year for 50 years.

Manual vegetation removal would help address the largest threat to TCB in the action area. Tree and tall-statured vegetation removal would improve habitat conditions for TCB by reducing competition for host plants, and by maintaining and increasing the total cover of the vegetative structure that TCB prefer. The removal of tall-statured vegetation would also increase the availability of sunlight in TCB habitat. TCB adults and larvae use solar heating and dark open ground to raise their body temperatures, an important requirement for metabolism and essential behaviors.

Holtrop and others (2013, p. 6) provided the following discussion on the importance of vegetation management in TCB habitat:

> "Vegetation dynamics and other habitat changes are likely the most common cause of local extinction for medium-sized and larger populations of butterflies (Thomas and Hanski 1997). Taylor's checkerspot utilizes open, grass or forb dominated openings, and has thermal requirements during all life stages. Reducing tree and shrub cover increases habitat patch size and the overall amount of habitat, allows butterflies to access key plants, and reduces habitat fragmentation. … Availability of sunlight can be limiting for larvae, which bask to increase body temperature and rates of digestion (Weiss et al. 1987, 1988). The faster the larvae develop, the better the chance of reaching diapause and contributing to the next generation (Weiss et al. 1987, 1988; Cushman et al. 1994)."

Tree and vegetation removal implemented to meet the terms of the SHA would have a significant beneficial effect on TCB in the action area. However, some adverse effects are reasonably certain to occur as an unavoidable result of working in occupied habitat. Foot traffic and vegetation management methods would result in some larvae in diapause being crushed. Risks would be reduced, but not eliminated, by performing the work during diapause. The potential for crushing TCB while implementing this work will be addressed in more detail under *Foot Traffic*, below.

Herbicide Application

Graysmarsh, pursuant to maintaining the established baseline condition, is likely to use spot-spray herbicide applications to treat invasive plants in the action area. It is possible that Graysmarsh would use broadcast herbicide applications as well, but the conditions that require broadcast applications may be rare. Broadcast herbicide applications (usually boom spray from a vehicle) are warranted when invasive plants have become so common that targeted application is not practical. In these situations, it is also likely that the habitat is losing any suitability for TCB. It is possible that these areas contain a low-density of host plants (particularly narrow-leaved plantain) but these areas would support far fewer individuals than high-quality sites of the same size. At Graysmarsh, we anticipate that broadcast applications in poor habitat would affect a similar number of TCB individuals as spot-spraying in high quality habitat. Therefore, the following discussion of the potential effects of herbicide application on TCB does not draw a distinction between spot-spray and broadcast applications.

Herbicides are commonly used to manage rare butterfly habitat and control invasive nonnative plants in south Puget Sound prairies (Schultz et al. 2011, p. 373). Herbicide applications can affect butterflies by damaging or destroying larval or adult food sources, or through the direct ingestion of a toxic substance. One method of reducing risk to host and larval plants is to use a grass-specific herbicide when grass is the plant targeted for eradication. Loss of nontarget plants can be minimized by using grass-specific herbicides, such as sethoxydim, which has been used effectively to control invasive grasses such as tall oatgrass (*Arrhenatherum elatius*), while having minimal impacts on native bunchgrasses and forbs (Schultz et al. 2011, p. 373).

There are currently dozens of herbicide formulations that are available for general use. The toxicity of an herbicide to butterflies varies from nontoxic to lethal depending upon the compounds used. All herbicides are required to be tested on honeybees (*Apis* spp.) as part of registration requirements, but there are relatively few studies that evaluate the effects of herbicides on butterflies. Herbicides that are reported to have a low risk to bees may not generalize to nontarget species, such as butterflies, due to differences in foraging, life history, habitat selection or other details of species' ecology (Russell and Schultz 2010, p. 54).

Use of the grass-specific herbicide compounds sethoxydim or fluazifop-p-butyl with the nonionic surfactant Preference® can affect butterflies, resulting in reduced larval survival and decreased rates of development from larvae to adult, as well as decreased wing area in some species of butterflies (Russell and Schultz 2010, p. 53). Survival of cabbage white butterfly larvae (*Pieris rapae)* was reduced by 32 percent with exposure to sethoxydim and 21 percent with fluazifo-p-butyl, while survival rates of Puget blue butterfly larvae (*Icaricia icarioides blackmorei*) were not reduced by exposure to these herbicides (Russell and Schultz 2010, p. 57). Herbicide exposure reduced wing size and pupal weights of cabbage white butterflies, while Puget blue butterflies experienced a 21 percent reduction in larval development time from the date of treatment to eclosure (Russell and Schultz 2010, p. 53).

Stark and others (2012, pp. 26-27) found that when early instar Behr's metalmark butterfly (*Apodemia virgulti*) larvae were exposed to field rates of triclopyr, sethoxydim, and imazapyr, the number of adults that emerged from pupation was reduced by 24 to 36 percent, perhaps due to effects from inert ingredients or indirect effects on food plant quality. Another study with the Karner blue butterfly (*Lycaeides melissa samuelis*) found that direct application of glyphosate to butterfly eggs had no apparent effect on egg survival and larval development; however, treatments with a glyphosate-triclopyr mix resulted in 22 percent reduction in egg hatching rates (Sucoff et al. 2001, p. 18). These studies indicate that the direct application of herbicide onto eggs, larvae, and larval host plants can result in reduced rates of larva-to-adult survival in some butterfly species, emphasizing the need for careful management using selective applications in habitats occupied by threatened or endangered butterfly species. Therefore, we will assume for this analysis that TCB is a species of butterfly that would be adversely affected by the application of herbicides in occupied habitats.

To summarize, some herbicides applications are likely to have adverse effects on TCB by causing host or nectar plant mortality during the season of use by TCB individuals as larvae or adults. Herbicides applications are also likely to adversely affect TCB larvae if the larvae consume treated vegetation or are directly exposed. Spot-spray applications target invasive plants, but there is a potential for adjacent host plants (and any TCB on those plants) to be exposed to herbicide. Broadcast applications would expose the low-density of individuals persisting in declining habitat. Based on the information presented above, this exposure is reasonably certain to result in sub-lethal or lethal effects to butterfly larva, and reduce overall survival rates from early instar development to adult emergence. However, we expect that Graysmarsh's commitment to coordinate with the Service regarding herbicide application in the established baseline habitat area (e.g., targeted application, less toxic formulations, and appropriate application timing) will minimize the risks of herbicide exposure to TCB. The resulting mortality would likely be significantly less than the 21 to 36 percent mortality rate suggested by the authors referenced above (Sucoff et al. 2001, Russell and Schultz 2010, Stark et al. 2012). Those higher mortality rates were associated with consistent and indiscriminant herbicide application across all plants and larva in the study. Instead, we can reasonably expect that relatively few larvae (less than one percent of the larval population) would be exposed to the herbicides applied to maintain or restore habitat, and that the incidental loss of larval host plants and nectar sources will be minimal.

Based on the analysis and assumptions above, herbicide application to the TCB-occupied established baseline area is reasonably certain to result in lethal and sublethal effects to less than one percent of the larval population present at the site each year. We anticipate that a small fraction of the established baseline habitat will require an herbicide application each year to maintain or restore habitat. An unknown number of TCB larvae associated with those 40.5 acres are reasonably certain to be killed from exposure to herbicides. The potential for crushing TCB while implementing this work will be addressed in more detail under *Foot Traffic*, below. TCB may also be exposed to herbicides applied in the agricultural areas of the enrolled property. These agricultural herbicide applications are not meant to maintain habitat for TCB and no minimization measures will be applied to reduce effects to TCB. However, few TCB from the Graysmarsh population are likely to disperse to the agricultural areas and be exposed to herbicide applications there. We conservatively assume that any TCB individuals in the agricultural areas will not survive exposure to herbicide applications in those areas.

While application of herbicides may result in mortality of TCB larvae, herbicides are recognized as a necessary tool for managing invasive plants and maintaining habitat for butterflies, and the butterfly populations they support. Invasive plants are a leading threat to at-risk butterfly populations and are directly linked to the decline and extirpation of TCB populations throughout the subspecies range (Stinson 2005, pp. 101-102). Conversion of a diverse prairie plant community to one dominated by invasive plants is clearly more deleterious to prairie butterflies than documented herbicide-induced impacts (Schultz et al. 2011, p. 373). Land managers in the south Puget Sound that are currently using herbicides to manage invasive plants at rare butterfly sites (including TCB sites) are successfully using best management practices to minimize effects to nontarget plant species with no observable negative impact to the local butterfly populations (e.g., Fimbel and Dunn 2012; Hays 2010). We anticipate a similar lack of population-scale impacts as a result of herbicide application associated with the implementation of the Graysmarsh SHA in the action area; in fact we expect the TCB population to positively respond to the use of herbicides as habitat conditions improve.

Infrastructure Maintenance

Graysmarsh will continue to maintain infrastructure on the enrolled property, and may construct new infrastructure when that construction is compatible with implementation of the SHA. This includes but is not limited to buildings, sheds, trails, roads, levees, bridges, benches, gates, signs, landscape architecture, parking areas, etc. Since the vast majority of these activities would take place away from where the majority of the TCB population reside, we expect the number of affected individuals to be low. However, TCB as eggs or larvae could potentially be crushed, dug up, or otherwise killed if they occur within the footprint of these activities.

<u>Buildings and Other New or Modified Construction</u>

Most of the buildings on the enrolled property are outside of the 40.5 acres of habitat most important to TCB and the implementation of the SHA. Future construction projects are likely to be sited near those other buildings. However, these buildings and developed areas could be visited by dispersing TCB during the term of the SHA. It is unlikely, but not extremely unlikely, that a construction project would occur on the same footprint as TCB eggs or larvae on the enrolled property. Any ground disturbance or construction on top of eggs or larvae would kill those individuals. We anticipate that this effect is reasonably certain to occur at least once during the proposed term of the Permit, and that it could happen essentially anywhere within 342 acres available to TCB on the enrolled property.

<u>Bridges, Levee, and Roads</u>

Graysmarsh will maintain bridges, levees, and roads on the enrolled property. Roads, in particular, intersect TCB habitat but bridges and levees also occur in close proximity to TCB habitat on the enrolled property. Using GIS, we estimate that there are 4.25 miles of roads on the portions of the enrolled property where TCB could occur, but TCB on the enrolled property primarily occupy Access Road A and part of Access Road B where it merges with Access Road A (0.8 miles). The effect of vehicles driving on these roads is discussed in *Road Use*, below.

Graysmarsh, in implementing the SHA, would maintain the current levee system on the enrolled property. Using GIS, we estimate that there is 0.5 mile of levees on the portion of the enrolled property where TCB could occur. The levee itself does not currently contain quality TCB habitat, so we do not expect that levee repairs would affect more than a few TCB individuals every few years. Similarly, Graysmarsh is expected to maintain bridges on access roads. The bridges also do not currently contain quality TCB habitat, so we do not expect that bridge repairs (either scheduled or emergency) would affect more than a few individuals every few years. We anticipate that TCB individuals are reasonably certain to be crushed during these activities at least once during the proposed term of the Permit, and that it could happen anywhere along the 4.25 miles of roads and 0.5 mile of levees.

Graysmarsh, in implementing the SHA, would maintain the current road system on the enrolled property. TCB primarily occupy approximately 0.8 mile of road in the action area, specifically Access Road A and part of Access Road B. Any road maintenance along Access Road A is likely to crush and kill TCB due to the frequent use of the road by TCB in multiple life stages.

TCB have a recognized affinity for the road surface and road shoulders at Graysmarsh (and roads elsewhere in the range of the species (Severns and Grosboll 2011, p. 66)). As described in the *Environmental Baseline*, TCB use Access Road A in all life stages. Fortunately, we do not expect that Access Road A will require significant maintenance because infrequent road use alone may sustain the road surface. Maintenance of this road is likely to be infrequent because the sandy soil is well-drained and traffic is rare and slow. Access Road B is likely to require more maintenance because it traverses the freshwater wetland. Maintenance on Access Road B may include grading, shoulder maintenance, ditch maintenance, culvert replacement, etc. There are 3.45 miles of roads elsewhere on the enrolled property that could potentially be visited by TCB during road maintenance. TCB occupancy coincident with road maintenance is expected to be infrequent but not extremely unlikely over the term of the Permit. Therefore, the extent of adverse effects from road, bridge, and levee maintenance may be as much as 4.75 miles during the term of the proposed permit, and more likely to occur in the 0.8 mile of occupied Access Road A and B.

Road maintenance could occur during any time of year; however, Graysmarsh would coordinate with the Service when implementing major repairs on Access Road A. Road maintenance that occurs outside of the active larval season (January 1 to September 30) is likely to affect fewer TCB individuals. During this time of year (October 1 to December 31), all individuals are in diapause. The first benefit of performing road maintenance during this timing window is that effects to adults and eggs are completely avoided. The second benefit is that the total number of larvae on the road surface, shoulders, and ditches is likely to be less than the numbers at those same locations during the active larval season. TCB larvae are mobile, and are known to crawl to locate better feeding, basking, and diapause locations. Little is known about where TCB spend diapause or how they select from available locations. However, we do know that TCB diapause in a sheltered spot under rocks, dry wood and vegetation, or in the soil and leaf litter at the base of a host or non-host plant (Moore 1989, p. 1727), and we anticipate that TCB are more likely to find and select better locations with shelter away from the compacted road surface. That selection behavior would reduce the total number of larvae on the road surface, shoulders, and ditches during the diapause season compared to the rest of the year, and therefore reduce the exposure of TCB individuals to road maintenance that occurs during the diapause season.

Agricultural Activities

Graysmarsh would likely continue agricultural operations on the enrolled property. Agricultural operations include but are not limited to annual seeding (plowing and disking) of barley, mowing lawns, moving and replacing irrigation lines, and managing and harvesting berries. As described in the *Environmental Baseline*, TCB occasionally inhabit the portion of the enrolled property where the majority of these activities occur, but mostly stay within the 40.5 acres previously described. Using GIS, we estimate that the agricultural area that TCB individuals may visit is 135 acres in size. TCB are most likely to be exposed to agricultural activities in their adult life history stage. Adults can disperse to the agricultural fields and may be attracted or retained there by nectar sources (e.g. strawberries and apple blossoms). Narrow-leaved plantain occurs in disturbed soil in this portion of the enrolled property at low densities, but TCB have never been observed to complete their life cycle in this area. Nevertheless, it is reasonably certain that a few eggs and caterpillars will be exposed to agricultural activities during the 50-year term of the proposed Permit.

The potential adverse effects to TCB from agricultural activities include foot traffic and vehicle traffic. Those adverse effects will be addressed in more detail under *Foot Traffic* and *Vehicle Traffic*, below. Other potential causes of mortality include mowing, plowing, or digging. TCB in the agricultural areas of the enrolled property could also be exposed to fertilizers, herbicides (see *Herbicide Application*, above), and pesticides (including insecticides). Since we do not have information to further assess the effects of exposure to whatever these products might be, we conservatively assume for this analysis that all individuals that disperse from the 40.5 acres of established baseline to the agricultural areas are killed or do not return to contribute to the population. Fortunately, Graysmarsh would meet the label requirements for any insecticides used and minimize the distance that those insecticides might drift by evaluating the interaction of environmental conditions and equipment before application. We predict that those efforts will be sufficient to avoid the drift of insecticides into the established baseline habitat area. Graysmarsh would also coordinate any insecticide use in the established baseline habitat area with the Service. The extent of these adverse effects is reasonably certain to reach 135 acres in some years during the 50-year term of the proposed Permit.

Annual Adult Surveys and Intermittent Baseline Surveys

Graysmarsh, in implementing the SHA, will continue to monitor the population of TCB on the enrolled property (Graysmarsh 2017a, p. 12). Annual adult surveys basically consist of a biologist walking through occupied habitat on established transects counting the adults that they see. Graysmarsh has committed to intermittent baseline vegetation surveys to document status relative to the established baseline of the SHA (Graysmarsh 2017a, pp. 12-13). Although not described in the SHA, Graysmarsh may also implement protocols for finding and counting TCB egg masses or larvae. All surveys for eggs, larvae, adults, or habitat conditions consist of a biologist walking through occupied habitat. The only significant effect of these surveys is crushing underfoot. The potential for crushing TCB while implementing surveys will be addressed in more detail under *Foot Traffic*, below.

Foot Traffic

In implementing the SHA, Graysmarsh will need to walk through habitat occupied by TCB. Foot traffic is a necessary component of habitat maintenance, annual adult surveys, recreation, and other activities on the enrolled property. Foot traffic in occupied habitats is likely to adversely affect TCB due to crushing TCB in all life stages. Adults are vulnerable during cold and wet weather when they are perched in a state of torpor and unable to flush away from foot traffic. Juvenile life stages are constantly vulnerable to being crushed by foot traffic unless they have entered diapause in a well-sheltered location. Graysmarsh has already reduced, but not eliminated, the probability of crushing TCB under foot by completing most of their vegetation management during the fall and winter months (approximately September to January), while TCB larvae are in diapause, and by managing public access to occupied habitat. As part of the SHA, Graysmarsh is committing to continued implementation of these measures.

The probability of foot traffic crushing TCB individuals is dependent on the frequency and timing of foot traffic and the abundance/density of TCB in the area. WDFW, while surveying a TCB site (Bald Hill in the South Puget Sound) in 2004, made a rough calculation of the percentage of individuals that were likely to be killed by foot traffic during transect surveys (Linders in litt. 2013). This reproducible calculation was based on a series of conservative assumptions and concluded that 0.36 percent of the population could be killed each year by crushing during three days of protocol transect surveys through densely occupied habitat. We believe this is a reasonable worst-case representation of likely effects for most on-foot activities within occupied habitat in the action area.

Implementation of the proposed SHA would largely sustain the current frequency of foot traffic within occupied habitat because the conservation measures identified above are currently being implemented. However, future habitat maintenance activities may result in an increase in foot traffic. Foot traffic is reasonably certain to result in crushing some TCB individuals in all life stages each year during the 50-year term of the permit. Using WDFW's conservative calculation for the impact of foot traffic during surveys, and increasing the estimate to account for other activities proposed that would involve foot traffic, we estimate that foot traffic is reasonably certain to result in the death of no more than 1 percent of the TCB individuals in the Graysmarsh population each year. However, given the uncertainties associated with this estimate, and the difficulty in applying this calculation to other anticipated types of foot traffic, it is better to describe these impacts in terms of the total area that is likely to receive foot traffic during the proposed term of the Permit. We anticipate that up to 342 acres of currently occupied or potentially occupied habitats at Graysmarsh will have some level of foot traffic each year. An unknown number of TCB associated with those acres are reasonably certain to be killed by that foot traffic, but we anticipate that only approximately one percent of the population will be so impacted.

Road Use

During implementation of the SHA, Graysmarsh will drive through habitat occupied by TCB. Road use is a component of several activities compatible with the SHA including light recreation and infrastructure maintenance. We estimate that there are approximately 4.25 miles of roads on the portions of the enrolled property where TCB could occur, but TCB on the enrolled property primarily occupy Access Road A and part of Access Road B where it merges with Access Road A (0.8 miles). Graysmarsh will need to drive Access Roads A and B (Figure 1) as described in the SHA, but will limit their use of these roads and public access to these roads (Graysmarsh 2017a, pp. 11-12).

Use of these roads by standard vehicles, golf carts, off-highway vehicles, horses, etc. is reasonably certain to result in the death or injury of all TCB life stages year-round. Adults are vulnerable during cold and wet weather when they are perched in a state of torpor and unable to flush away from vehicles. Juvenile life stages are constantly vulnerable to being crushed by vehicles because some larvae may even choose to diapause on a road.

Road use is likely the most significant anthropogenic source of TCB mortality in the Graysmarsh population currently, and will continue to be the most significant anthropogenic source of TCB mortality in the Graysmarsh population for the duration of the proposed Permit. Approximately 90 percent of egg masses are oviposited on host plants on or immediately adjacent to Access Road A (Severns and Grosboll 2011, p. 17). Road traffic could therefore crush and kill substantial number of larvae (a large proportion of the population) at the wrong time of year. However, light use of the Access Road A is an on-going activity that the population has survived through for as long as the population has been known and monitored. Road use on Access Road A maintains the sparsely vegetation condition that TCB and their host plants prefer. Graysmarsh will continue to reduce, but not avoid, the probability of crushing TCB with vehicles by limiting their use of Access Road A from January 1 to September 30.

Implementation of the proposed SHA would essentially sustain the current frequency of road use that occurs within occupied habitat at Graysmarsh. Road use is reasonably certain to result in crushing TCB individuals in all life stages each year during the 50-year term of the permit. Estimating the number of TCB individuals actually affected by road use is difficult because we do not know the exact frequency of road use or the exact number of individuals in the tire tracks. Given those uncertainties, the extent of TCB crushed or killed is better described in terms of total road miles that would be driven on. We used GIS to estimate the total roads on the enrolled property where adverse effects from road use is reasonably certain to occur at least once in the duration of the Permit and anticipated 4.25 miles of adverse effects. As described above, TCB will mostly be killed by road use on Access Road A and part of Access Road B (0.8 miles). An unknown number of TCB associated with those acres are reasonably certain to be killed by road use.

Effects of Early Termination

Graysmarsh can implement the SHA for its full 50-year term and then return to established baseline conditions, or they can decide to terminate the SHA at any time and return to established baseline conditions. Depending on timing of an early termination, there could be different amounts of habitat in the SHA area. As long as they have, at a minimum, the designated habitat to meet the agreed-upon baseline, they are in compliance with that aspect of the SHA. If habitat levels go below the specified baselines, they are not in compliance with the SHA. Unless there are significant changed circumstances like salt water inundation of the baseline habitat, the Service expects that Graysmarsh will implement the SHA for the full permit term. We expect that habitat levels will always be at or above the elevated baseline conditions specified in the SHA because Graysmarsh has interest in retaining regulatory assurance.

If Graysmarsh does choose to terminate the SHA early, they would no longer be required to maintain the habitat at or above the established baseline. Additionally, they would be able to return the habitat to the baseline that was established. However, there is no reason for Graysmarsh to intentionally degrade the habitat through, for example, selectively digging up plants. A more likely outcome of early termination is a slow, incidental return to baseline because encroaching trees, shrubs, and invasive plants would no longer be controlled. Early termination could lead to significant threats to the TCB population at Graysmarsh, but implementation of the SHA over any period of time is better for the species, particularly in light of impending population loss due to sea level rise.

Summary of the Adverse Effects of the Proposed Action

TCB in the action area are likely to be adversely affected by exposure to herbicides, infrastructure maintenance, agricultural activities (including insecticides), foot traffic, and road use. Adverse effects to TCB, primarily in the form of crushing TCB individuals as larvae, are likely to occur on up to 40.5 acres of habitat maintained for TCB, 301.5 acres outside of the established baseline, 4.25 miles of roads, and 0.5 miles of levees each year during the 50-year term the proposed Permit (Table 2). The actual number of individuals that may be killed is unknown and likely to be highly variable. Foot traffic and road use on Access Road A are the anticipated activities with the greatest certainty to kill substantial numbers of larvae each year of the proposed Permit.

Table 2. Extent of adverse effects to TCB from implementation of the SHA.

Activity	Estimation of Extent of Adverse Effects Per Year
Herbicide Exposure	175.5 acres
Infrastructure Maintenance	4.25 miles (roads), 0.5 mile (levees) and 342 acres (other)
Agricultural Activities	135 acres
Foot Traffic	342 acres
Road Use	4.25 miles

Summary of the Beneficial Effects of the Proposed Action

Issuance of the Permit to Graysmarsh and subsequent implementation of the SHA has clear beneficial effects for TCB. Beneficial activities for TCB are proposed to occur throughout the 40.5 acres of established baseline habitat. Maintenance and potentially improvement of the established baseline habitat is expected to diminish key threats to the TCB population and ensure that habitat is retained during the 50-year term of the Permit. Specifically, seeding and plugging appropriate plants, manual vegetation removal, and herbicide treatments would be beneficial to TCB when applied in a way that maintains or restores the habitat. Annual surveys for TCB adults would have indirect beneficial effects for TCB in the action area because that information could inform management decisions.

EFFECTS OF THE ACTION: TAYLOR'S CHECKERSPOT BUTTERFLY CRITICAL HABITAT

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

On October 3, 2013, the Service designated critical habitat for TCB under the ESA. The critical habitat designation includes three CHUs which encompass approximately 1,941 acres in Island, Clallam, and Thurston Counties in Washington, and in Benton County, Oregon (78 FR 61506-61589). The critical habitat designation within the three CHUs is further subdivided into 11 subunits. Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of TCB critical habitat consist of four components (78 FR 61576-61577): 1) patches of early seral, short-statured, perennial bunchgrass plant communities, 2) primary larval host plants, 3) adult nectar sources, and 4) aquatic features.

Graysmarsh, in implementing the SHA, may affect critical habitat for TCB. All of the activities associated with maintaining baseline conditions, as well as a suite of other activities compatible with the SHA, would occur within critical habitat: specifically all 151 acres of CHU 2-D (78 FR 61524). Activities within these 151 acres may result in the temporary or permanent removal of the PCEs. However, the PCEs that contribute to the established baseline of the SHA would be maintained or improved during the 50-year term of the Permit. The following analysis describes the anticipated effects on each of the PCEs, and analyzes the effects to the established baseline area and to the rest of the CHU separately.

PCEs 1, 2, and 3

<u>Within the 40.5 acres of Established Baseline Area</u>

Implementation of the SHA is likely to maintain or increase the size, quality, and distribution of early seral, short statured, perennial bunchgrass plant communities, primary larval host plants, and adult nectar sources. PCEs 1, 2, and 3 in at least 13 acres and potentially up to 40.5 acres would be maintained or improved in designated critical habitat. As described in the SHA, those 13 acres support the majority of the high quality PCEs on the enrolled property. Habitat maintenance or restoration activities consistent with the SHA are anticipated to be wholly beneficial to the PCEs of TCB critical habitat. No short-term or long-term adverse effects to critical habitat are anticipated from those activities that maintain or improve the established baseline (seeding and plugging, manual vegetation removal, and herbicide applications).

We also anticipate some activities within the 40.5-acre established baseline area that are not wholly beneficial to the PCEs of critical habitat. Specifically, infrastructure maintenance (buildings, bridges, levees, and roads) could occur within this area and remove PCEs (temporarily or permanently) as long as those impacts would not reduce habitat conditions below established baseline. These effects are likely to be sporadic (not every year) and limited to small footprints (edges of existing roads, levee slopes, etc.). Infrastructure maintenance compatible with the SHA would not reduce the function of the critical habitat for supporting the TCB population at Graysmarsh.

Within the 110.5 acres of CHU outside of the Established Baseline Area

There are 110.5 acres of critical habitat on the enrolled property that are outside of the established baseline area. We anticipate that activities, specifically infrastructure maintenance and agricultural activities, would temporarily or permanently remove PCEs in this location during the term of the proposed Permit. PCE 3, in particular, would be routinely established and then removed because agricultural activities include growing plants like strawberries that are nectar sources. The quantity and quality of PCEs in this portion of the CHU are limited. With or without the proposed Permit, the quantity and quality of PCEs in this location are likely to continue to be poor. Estimating the footprint of anticipated adverse effects is difficult because the exact size, number, and configuration of projects causing these effects is not predictable, and adverse effects are expected to occur in very small and oddly shaped areas (measured in tens of square feet or less). Additionally, adverse effects to critical habitat may happen in the same locations multiple times if the first effect was temporary.

PCE 4

Aquatic features in critical habitat may be affected by SHA implementation. Specifically, Graysmarsh would maintain and repair the levee, and maintain and repair Access Road B where it crosses freshwater features. However, we do not anticipate any significant effects to aquatic features in critical habitat because Graysmarsh committed to maintain those features as part of the established baseline. Therefore issuance of the proposed Permit would have only insignificant effects on PCE 4.

Summary of Effects to TCB Critical Habitat

Actions taken under the SHA to maintain or improve the established baseline would be wholly beneficial for PCEs 1, 2, and 3 of designated critical habitat for TCB. Issuance of the proposed Permit would also have insignificant effects on PCE 4 because Graysmarsh has committed to maintain aquatic features as part of the established baseline. However, PCEs 1, 2, and 3 would occasionally be adversely affected during the term of the proposed Permit at very small spatial scales. These adverse effects would be associated with the agricultural activities and maintenance of infrastructure. Overall, implementation of the SHA is expected to result in benefits that are much more significant to ensuring the future function of critical habitat than the anticipated minor degradations of PCEs 1, 2, and 3. The quality of critical habitat in the action area will be maintained or improved over the term of the proposed Permit, even though those benefits would be concentrated in the acres that comprise the established baseline instead of throughout the CHU.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The action area is entirely owned and managed by Graysmarsh, and the ESP would authorize incidental take for all future activities on the enrolled property as long as Graysmarsh is in compliance with the SHA. In this Opinion we described all future activities that are reasonably certain to occur. Therefore, there are no other state, tribal, local, or private actions that are reasonably certain to occur in the future in the action area.

INTEGRATION AND SYNTHESIS OF EFFECTS

Taylor's Checkerspot Butterfly

The proposed Permit would authorize the implementation of a SHA at Graysmarsh for 50 years. The enrolled lands include all of the Graysmarsh population of TCB, which is the last extant TCB population living in a stabilized sand dune environment. Since the enrolled property includes all of that known population, and activities related or incidental to the SHA represent the vast majority of actions that may affect this population in the next 50 years, this Opinion is a unique opportunity to evaluate all anthropogenic stressors affecting this population of TCB. The analysis below will reiterate key points about the status of the species, the condition of the action area, and the conservation role of the action area before touching on the anticipated effects of permit issuance and examining the relative importance of direct anthropogenic mortality compared to climatic and habitat conditions. In this *Integration and Synthesis* section, the Service typically considers the anticipated effects of the proposed action to the species in light of, or in addition to, cumulative effects. However, because the TCB population at Graysmarsh is situated well within the sole ownership and management of Graysmarsh and included in the enrolled lands for this SHA, and the Permit includes all future activities compliant with the SHA, we do not have any cumulative effects to consider in this section of the analysis.

TCB is in danger of becoming extinct throughout all or a significant portion of its range. Fortunately, the number of known populations has increased since the listing determination was made in 2013, and the status of some reintroduced populations has improved. In the *Status of the Species*, we indicated that habitat for TCB requires active management to prevent the establishment of invasive, nonnative, and native woody species, and restoration by actively managing sites to establish native plant species and a structurally suitable plant community. We also indicated that small and isolated populations of TCB are especially vulnerable to adverse weather conditions and other stochastic events.

We established in the *Environmental Baseline* that 40.5 acres in the action area, and 13 acres in particular, support a unique population of TCB. Key features of the site include narrow-leaved plantain growing on Access Road A, a high proportion of open ground, and blue-eyed Mary growing in proximity to narrow-leaved plantain. The population is primarily threatened by the spread of invasive grasses and by sea level rise. The conservation role of the action area is to continue to sustain a unique population of TCB that is important for the recovery of the species. This population contributes to the abundance, distribution, and genetic diversity of the species (whereas other populations of TCB may only contribute in one of those aspects). This is one of the largest populations of TCB in the range of the species and is the only habitat where TCB still persist in a stabilized sand dune environment. This TCB population has been on a path of divergent evolution from other TCB populations as evidenced by some unique genetic characteristics (Severns et al. 2013). Therefore, the survival of the TCB population at this location is an important condition for ensuring the conservation of the species.

As described in the *Effects of the Proposed Action*, we anticipated adverse effects to TCB individuals of all life stages during the term of the proposed Permit. Those adverse effects would be a result of 1) exposure of TCB to herbicide applications, 2) TCB killed during infrastructure maintenance, 3) TCB killed during agricultural activities, 4) TCB killed by foot traffic, and 5) TCB killed by vehicles on roads. TCB dependence on Access Road A means that there is certain minimal level of road use necessary to balance indirect effects on habitat quality and direct effects on TCB individuals. However, implementation of the SHA would maintain or potentially improve habitat for TCB, which is crucial for the management-dependent TCB population.

Incidental mortality of TCB during habitat maintenance activities is unavoidable due to their small size, year-round occupancy, and the short and fragile nature of their lives. Similarly, incidental mortality beyond the established baseline is unavoidable. Our analysis of that incidental mortality and its consequences to the persistence of the species necessarily considers the complicated role that mortality and reproduction play in TCB population dynamics. The following discussion highlights the dynamic nature of TCB abundance even in unimpaired TCB populations and the important role that habitat and weather conditions play in determining population size and persistence.

TCB is an 'r-selected' species (MacArthur and Wilson 1967) with a huge potential for population growth and a close relationship with weather patterns and, subsequently, host and nectar plant abundance, diversity, and phenology. Female TCB can lay up to 1,200 eggs (James and Nunnallee 2011, p. 286; Linders and Lewis 2013, p. 13), but an average number of eggs laid may be closer to 100-400 (Linders 2009, p. 6; Linders and Lewis 2013, pp. 12-14) depending on body condition of the female. In the closely related bay checkerspot butterfly (*Euphydryas editha bayensis*), Cushman and others (1994) calculated that for an adult generation of checkerspots to replace itself, only 10 of those hundreds of eggs need to reach diapause. However, checkerspot butterflies experience high rates of mortality. "This reproductive output represents a huge potential for growth, but in most populations and in most years, nearly all immature individuals die before reaching reproductive stage" (Hellman *et al*. 2004, p. 41). "Of the many eggs that a female butterfly lays, on average [across all butterfly species], only two survive to reach adulthood" (Scott 1986, *in* Stinson 2005, p. 83). In bay checkerspot butterflies, pre-diapause larva mortality rates alone can be 90-95 percent (Murphy and Weiss 1988).

An important buffer to the large effect that weather has on host plant phenology and pre-diapause larvae is the amount of habitat heterogeneity in the site occupied by a TCB population. The topographic heterogeneity composed of swales, hills, shaded areas, wet areas, etc. provides important refugia for sub-populations of host plants that may persist earlier or longer in the season. "The same weather conditions are likely to affect adjacent populations differently, depending on the presence of different host plants, topography, and disturbance patterns" (Hellman et al. 2004 pp. 44-45). Weiss and others (1987, 1988, cited in Stinson 2005, p. 86) found that some populations in larger, homogenous habitats were extirpated by adverse weather conditions while populations in smaller patches with more diverse topographies and microclimates persisted through the same weather event. This information is critical to evaluating the probability of TCB persistence in an area and the relative importance of anthropogenic effects in those areas. Some TCB populations in Washington have exhibited successful years with several thousand individuals and then declined dramatically with only 100 or so butterflies remaining the following year (Stinson 2005, p. 85). The population of TCB in the action area does not utilize a particularly large piece of habitat, and the topography is fairly flat. But, this population has persisted for as long as the Service has been aware of it, and peak daily counts have varied less than an order of magnitude since first discovery (Table 1). We infer that there must be some type of habitat heterogeneity in the established baseline that has contributed to this apparent stability and resilience.

The proposed Permit will have a significant positive effect on maintaining TCB abundance and distribution and ensuring population stability compared to not issuing the Permit. We anticipate that outcome because, as described in the previous paragraphs, habitat conditions are a more significant controller of TCB abundance and persistence than direct sources of mortality that occur on a limited spatial scale (e.g., footprints, tire tracks, or spot spraying of herbicide). The limitations on access to and use of Access Road A and other commitments to coordinate with the Service on certain actions included in the SHA (e.g., herbicide selection) are expected to effectively reduce those direct anthropogenic sources of mortality. Some analysis has already been done on the impact of direct anthropogenic mortality on checkerspot butterfly populations relative to weather and habitat related factors. Specifically, a long term population monitoring effort examined the effects of destructively sampling adult bay checkerspot butterflies on Jasper Ridge from 1960 to 1986. Researchers concluded that "population reductions due to destructive sampling were small relative to variability caused by environmental conditions" (Harrison et al. 1991; *in* Hellman et al. 2004, p. 57); "… research and other direct human factors may have reduced persistence time marginally… but impacts of other factors were considerably more important" (Hellman et al. 2004, p. 58). Maintenance of the quality, quantity, and distribution of TCB habitat is paramount. "Butterfly conservation is usually best accomplished through habitat preservation, in part, because their numbers cannot be readily managed" (New et al. 1995; *in* Stinson 2005, p. 85).

Climate change and associated sea level rise are occurring in the action area and will continue throughout the 50-year duration of the proposed Permit. We established in the *Environmental Baseline* that the population will possibly be extirpated by sea level rise in the next 50 years. These changing conditions are likely to interfere with the successful implementation of the SHA. Implementation of the SHA, over any length of time, protects the Graysmarsh TCB population from significant habitat degradation associated with encroaching shrubs, trees, and invasive grasses. But, implementation of the SHA is not likely to ameliorate the threat of sea level in the final years of the proposed Permit duration.

Historically, TCB had adequate opportunities to demographically support or recolonize populations that were locally extirpated by weather conditions, but this is no longer the case in the vast majority of the remaining range of the species. The Service is not aware of any suitable habitats within dispersal distance of the action area. It is unlikely that the population at Graysmarsh would be recolonized if it were extirpated and it is also unlikely that individuals from the Graysmarsh population will colonize new habitats or participate in genetic exchange with other extant populations of TCB. For the conservation of TCB "… there will need to be an ability to recolonize new habitat and provide for genetic exchange, which is essential to the long term viability (survival) of the species" (77 FR 61976-7). The Service intends to evaluate the need and practicality of relocating this population to habitats above tidal inundation, and would potentially work with other partners to create those habitats if they do not currently exist. Graysmarsh would provide the Service access to translocate TCB individuals. This proposed Permit serves to protect the population from a significant threat (habitat degradation) until translocation can be arranged.

Incidental mortality associated with the implementation of the SHA is not expected to measurably reduce TCB distribution in the action area, and the reduction in numbers and reproduction associated with implementation of the SHA is not expected to increase the likelihood of extirpation. In fact, implementation of the SHA will have a significant positive effect on maintaining TCB numbers and distribution and ensuring population stability by addressing one of the greatest threats in the action area: the encroachment of woody trees and shrubs and the establishment of invasive species. Other benefits of issuing the Permit, though indirect, include the annual adult surveys and research opportunities described in the SHA. We anticipate that the TCB population in the action area will persist until such a time that the Service and other conservation partners can determine an appropriate response to sea level rise, which may include the translocations of TCB individuals to new habitats. The conservation role of the action area would be retained for as long as it can be within the abilities of the Service and Graysmarsh. Therefore, we do not expect that issuance of the proposed Permit would result in an appreciable reduction in the likelihood of survival and recovery of TCB in the wild at the scale of the action area or within the listed range of the species.

Taylor's Checkerspot Butterfly Critical Habitat

Implementation of the Graysmarsh SHA under the proposed Permit would have beneficial and adverse effects in CHU 2-D. Since the enrolled property includes all of CHU 2-D, and activities related or incidental to the SHA represent the vast majority of actions that will occur in this CHU in the next 50 years, this Opinion is a unique opportunity to evaluate all anthropogenic stressors affecting the PCEs of critical habitat in the action area. The analysis below reiterates key points about the status of the critical habitat, the condition of critical habitat in the action area, and the conservation role of the action area before discussing the anticipated net effects of issuance of the Permit and implementation of the SHA on the function of this critical habitat for the recovery of TCB. In this *Integration and Synthesis* section, the Service typically considers the anticipated effects of the proposed action to the critical habitat in light of, or in addition to, cumulative effects. However, because the designated critical habitat for TCB in CHU 2-D is under sole ownership and management of Graysmarsh and included in the enrolled lands for this SHA, we do not have any cumulative effects to consider in this section of the analysis.

In the *Status of the Critical Habitat*, we stated that all areas designated as critical habitat will require some level of management to address the current and future threats to the TCB to maintain or restore the PCEs. But in the *Environmental Baseline*, we said that the PCEs are not evenly distributed in the action area. Therefore, future management in CHU 2-D need not be ubiquitous to maintain current function, and that is in alignment with the proposed SHA for

Graysmarsh that aims to maintain 40.5 acres of the best and most functional habitat. Critical habitat in the action area contains all four PCEs, but the quality of critical habitat remains threatened by encroachment of woody trees and shrubs and the establishment of invasive species. The functionality of a large portion of the critical habitat in the action area is also threatened by sea level rise. The conservation role of the action area, as described above, is to sustain a unique population of TCB that is important for the recovery of the species.

In the *Effects of the Proposed Action* section, we anticipated adverse effects to PCEs 1, 2, and 3, within 151 acres of critical habitat on the enrolled property, but concluded that overall, implementation of the SHA under the proposed Permit would maintain and potentially increase the size, quality, and distribution of early seral, short-statured, perennial bunchgrass plant communities, primary larval host plants, and adult nectar sources. Habitat maintenance is a net benefit because the persistence of critical habitat for TCB is dependent on management activities. Despite anticipated yearly small-scale adverse effects from infrastructure maintenance and agricultural activities to three of the PCEs of critical habitat, the function of critical habitat in the action area would not be reduced. Implementation of the SHA would maintain and potentially improve the quality, density, and distribution of PCEs within the established baseline habitat.

Climate change and associated sea level rise are occurring in the action area and will continue throughout the 50-year duration of the proposed Permit. We established in the *Environmental Baseline* that the function of critical habitat will be significantly reduced by tidal inundation. These changing conditions are likely to compromise the beneficial effects of the proposed Permit. However, implementation of the SHA, over any length of time, increases the conservation function of the critical habitat unit compared to not issuing the proposed Permit and not implementing the SHA. As explained above, the Service intends to evaluate the need and practicality of relocating this population to habitats above tidal inundation, and this proposed Permit serves to maintain the functionality of the critical habitat until that issue is resolved. Accordingly, the function of CHU 2-E and critical habitat range-wide would not be diminished by the proposed action, and would remain functional to serve its intended recovery role for as long as possible. Therefore, we anticipate that the proposed Permit would not reduce the value of designated critical habitat for the conservation of the species.

CONCLUSION

After reviewing the current status of TCB and designated critical habitat for TCB, the environmental baseline for the action area, the effects of the Service’s proposed issuance of a section 10(a)(1)(A) Permit to Graysmarsh, and the cumulative effects, it is the Service's Opinion that the issuance of a section 10(a)(1)(A) Permit to Graysmarsh, as proposed, is not likely to jeopardize the continued existence of TCB or destroy or adversely modify designated critical habitat for TCB.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed SHA and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the proposed SHA and any Section 10(a)(1)(A) permit or permits issued with respect to the proposed SHA, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR §402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under Section 10(a)(1)(A) and Section 7(o)(2) of the Act to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the Section 10(a)(1)(A) permit and Section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed SHA, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the SHA and its accompanying Section 10(a)(1)(A) permit.

AMOUNT OR EXTENT OF TAKE

The Service expects that the incidental take of individuals will be difficult to detect or quantify for the following reasons: 1) levels of mortality are naturally high among invertebrate species, especially during early life stages, 2) assessments or verification of mortality are difficult because detection of individuals under field conditions is difficult, particularly during early life stages, and 3) the numbers affected may vary widely from year to year with fluctuating population levels, densities, and environmental conditions. However, pursuant to 50 CFR 402.14(i)(1)(i), a surrogate can be used to express the anticipated level of take in an incidental take statement (ITS), provided three criteria are met: (1) measuring take impacts to a listed species is not practical; (2) a link is established between the effects of the action on the surrogate and take of the listed species; and (3) a clear standard is set for determining when the level of anticipated take based on the surrogate has been exceeded.

The Service acknowledges that in many cases the science related to the habitat requirements and behavior of the listed species informs the analytical basis for establishing a causal link between the effects of the proposed Federal action to habitat and take of the listed species. A habitat-based approach to evaluating the effects of proposed Federal actions on listed species is a customary practice of the Service in biological opinions. For these reasons, quantifying and monitoring take impacts via project effects to the habitat of the listed species, not a surrogate species, is a scientifically credible and practical approach for expressing and monitoring the anticipated level of take for situations where use of a surrogate is warranted.

The following discussion presents the Service's analysis and findings with respect to the three regulatory criteria for use of a surrogate in this ITS to express the anticipated level of take likely to be caused by the proposed action.

The following amount or extent of take can be described through the quantity of occupied habitat that would be impacted by activities associated with the implementation of the SHA that we have identified as reasonably certain to cause incidental take. The use of this surrogate is warranted because it will be roughly proportional to the number of individuals injured or killed and can be effectively monitored to ensure the amount or extent of take is not exceeded. Therefore, the following forms and extent of incidental take are expected for a duration of 50 years:

- Harm of eggs and adults during the flight season (April 1 to June 15) and larvae year-round, each year, associated with herbicide applications on 40.5 acres of the established baseline and 135 acres of agricultural land in the action area.

- Harm of eggs and adults during the flight season (April 1 to June 15) and larvae year-round, each year, associated with infrastructure maintenance in small footprints over 342 acres, 4.25 miles of roads, and 0.5 mile of levees in the action area.

- Harm of eggs and adults during the flight season (April 1 to June 15) and larvae year-round, each year, associated with agricultural activities on 135 acres in the action area.

- Harm of eggs and adults during the flight season (April 1 to June 15) and larvae year-round, each year, associated with foot traffic on 342 acres in the action area.

- Harm of eggs and adults during the flight season (April 1 to June 15) and larvae year-round, each year, from vehicle traffic associated with 4.25 miles of established roads in the action area.

EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

REASONABLE AND PRUDENT MEASURES

The conservation measures negotiated in cooperation with the Service and included as part of the SHA constitute all of the reasonable and prudent measures necessary to minimize the impacts of incidental take. On that basis, no reasonable and prudent measures except for monitoring and reporting requirements are included in this Incidental Take Statement.

1. The monitoring and reporting plans described in section 4.2.4 of the SHA include, but are not limited to, commitments to monitor and report on the implementation of covered activities as well as the conditions of designated baseline habitat and species occurrences. The monitoring plan will provide the best available data to monitor and report on the amount or extent of take, per 50 CFR 402.14(i)(1)(iv).

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, Graysmarsh must comply with the following term and condition which implements the reasonable and prudent measure described above and outlines required reporting/monitoring requirements. This term and condition is non-discretionary.

1. Implement the monitoring and reporting plans described in Section 4.2.4 of the SHA.

The Service believes that no more than the extent of take described above will occur as a result of the proposed action. The reasonable and prudent measure, with its implementing term and condition, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measure provided. The Service must then immediately review the need for possible modification of the reasonable and prudent measure.

The Service is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We do not have any conservation recommendations to offer.

REINITIATION NOTICE

This concludes formal consultation on the proposed issuance of a Permit to Graysmarsh. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A
STATUS OF THE SPECIES: TAYLOR'S CHECKERSPOT BUTTERFLY

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Appendix A
Status of the Species: Taylor's Checkerspot Butterfly

Legal Status

The Taylor's checkerspot butterfly (*Euphydyas editha taylori*) was listed as an endangered species on October 3, 2013, throughout the subspecies range in Washington, Oregon, and British Columbia (78 FR 61452 [October 3, 2013]). The primary reasons for listing included extensive habitat loss through conversion and degradation of habitat, particularly from agricultural and urban development, successional changes to grassland habitat, military training, and the spread of invasive plants; inadequate existing regulatory mechanisms that allow significant threats such as habitat loss; and, other factors, including low genetic diversity, small or isolated populations, low reproductive success, and declining population sizes. Classified as an endangered species, the Taylor's checkerspot butterfly is considered to be presently in danger of extinction throughout its entire range.

Taxonomy and Species Description

The Taylor's checkerspot is a butterfly in the Order Lepidoptera (butterflies and moths), and family Nymphalidae (brushfoots), subfamily Melitaeinae (checkerspots). Taylor's checkerspot butterfly is a medium-sized (less than or equal to 2.25 inches), colorfully marked butterfly with a checkerboard pattern on the upper (dorsal) side of the wings (Pyle 2002, p. 310). The upperside of the wings are black with orange and yellowish (or white) spot bands, giving them a checkered appearance (Pyle 2002, p. 310). Taylor's checkerspot is one of several subspecies of the Edith's checkerspot butterfly (*Euphydryas editha*), that includes the threatened bay checkerspot (*E. e. bayensis*) and the endangered Quino checkerspot (*E. e. quino*) which occur in California.

Habitat

Taylor's checkerspot butterfly requires open grassland habitat dominated by short-statured grasses, with abundant forbs to serve as larval host plants and nectar sources. These habitats are found on prairies, shallow-soil balds (Chappell 2006, p. 1), grassland bluffs, and grassy openings within a forested matrix on south Vancouver Island, British Columbia; the north Olympic Peninsula; south Puget Sound, Washington; and the Willamette Valley, Oregon. Occupied habitats range in elevation from near sea-level to over 3,200 ft in elevation, and occupied grassland patches range in size from less than 1 acre up to 100-plus acres (0.4 to 40 ha).

In British Columbia, Canada, Taylor's checkerspot butterflies were historically known to occupy coastal grassland habitat on south Vancouver Island and the nearby Gulf Islands, not forests that were converted to early successional conditions by clear-cutting. The recently discovered population on Denman Island in Canada, discovered in May 2005, occupies an area that had been clear-cut harvested, and is now dominated by grass and forb vegetation, but is changing rapidly and requires management to maintain early seral conditions.

In Washington, Taylor’s checkerspot butterflies inhabit glacial outwash prairies in the south Puget Sound region. Northwest prairies were formerly more common, larger, and interconnected, and supported a greater distribution and abundance of Taylor's checkerspot butterflies than prairie habitat does today. On the north Olympic Peninsula they use shallow-soil balds dominated by prairie forbs and bunchgrasses within a forested landscape, as well as roadsides, former clear-cut areas within a forested matrix, and a coastal stabilized dune site near the Strait of Juan de Fuca (Stinson 2005, pp. 93–96). The two Oregon sites are on grassland hills in the Willamette Valley within a forested matrix (Ross 2008, p. 1; Benton County 2010, Appendix N, p. 5). The total area and quality of habitat for the Taylor’s checkerspot butterfly has rapidly declined over the past century due to development, conversion, successional changes to grassland habitat, and the spread of nonnative invasive plants.

Biology and Life History

Annual Life Cycle

The Taylor’s checkerspot butterfly is univoltine (producing a single generation per year) and is nonmigratory. All butterflies have four stages of development (egg, larvae, pupae, and adult). Taylor’s checkerspot butterflies emerge as adults in the spring, typically flying in May, although depending on local site and climatic conditions, the flight period may begin in April (Stinson 2005, p. 79) and extends into June, as in Oregon, where the flight season has been documented as lasting up to 43 days (Ross 2008, p. 3). The life-span of individual adult butterflies is usually brief, lasting only 4 to 14 days (Cushman et al. 1994, p. 196). During the flight period adult butterflies patrol their habitat for mates, nectar sources and host plants. Adult checkerspot butterflies are non-migratory, rarely dispersing from their natal habitats (Singer and Hanski 2004, pp. 184-185). Males seek females for mating, and once mated, the females seek larval host plants on which to lay eggs (oviposit). Female *E. editha* generally only mate once and may lay up to 1,200 eggs in clusters of 20 to 350 directly onto larval host plants (James and Nunnallee 2011, p. 286). Captive Taylor’s checkerspot typically produce 100-400 eggs depending on body condition of the female (Linders and Lewis 2013, pp. 12-14). Eggs hatch after 13 to 15 days (Murphy et al. 2004, p. 25). In *E. editha*, newly hatched caterpillars live colonially in a loose silk web during early development. The web is thought to deter generalist predators and parasitoids (Kuusaari et al. 2004, p. 139).

Checkerspot larvae (caterpillars) feed on the green leaves and flowers of host plants and undergo a series of molts as they develop. The larval stages between molts, called instars, express changes in color or markings. Taylor’s checkerspot larvae generally grow through four or five instars during the spring and early summer months, and then enter diapause during mid- to late summer and will overwinter in this state until the following late winter or early spring (Guppy and Shephard 2001, p. 311). Diapause is a dormant state similar to hibernation when no feeding, growth or development occurs (Scott 1986, p. 26). Larvae of *E. editha* diapause in a sheltered spot under rocks, dry wood and vegetation, or in the soil and leaf litter at the base of a host or nonhost plant (Moore 1989, p. 1727). Prediapause larvae race to mature before host plants dry out and become unpalatable. First and second instar larvae cannot enter diapause, so if host plants senesce too early, the larvae suffer high rates of mortality (Murphy et al. 2004, p. 26). Prediapause larvae move to new host plants when a host becomes completely eaten, and may shift to an alternate host plant species with changes in palatability as the season advances (Hellmann et al. 2004).

When temperatures begin to rise in late February or March, the caterpillars break diapause and resume feeding as post-diapause larvae for several weeks (Stinson 2005, p. 80). When the caterpillar is fully grown (5th instar) it forms a pupa, and undergoes metamorphosis into the adult form. Pupation lasts about two weeks, after which the adult butterfly ecloses (emerges) and lives for a few days to two weeks (Stinson 2005, p. 80). All nontropical checkerspot butterflies, including the Taylor's checkerspot butterfly, have the capability to reenter diapause prior to metamorphosis during years that weather is extremely inhospitable or when the larval food resources are restricted (Ehrlich and Hanski 2004, p. 22). The portion of the larval population that overwinters for a 2nd year is unknown, but may be as high as 30 to 50 percent in some years (Oregon Zoo 2009, cited in COSEWIC 2011, p. 36). Larvae that overwinter for a second year may aid in local population persistence during years when conditions are unfavorable.

Areas of habitat with open bare soil are an important habitat component for the butterfly as these areas warm more quickly than the surrounding vegetation, and butterflies thermoregulate by basking (Scott 1986, p. 296; Kuussaari et al. 2004, p. 140; Stinson 2005, p. 81). Post-diapause larvae forage singularly and are capable of moving much greater distances than pre-diapause larvae (Kuussaari et al. 2004, p. 140). Edith's checkerspot larvae have been documented to move up to 10 m (33 ft) from a release site, often moving within a habitat patch to different exposures to raise their body temperature, and presumably to find suitable foraging conditions (Kuussaari et al. 2004, p. 140). Dispersal within a habitat patch benefits the larvae because they are able to elevate their body temperature to an optimal range for foraging and development (Kuussaari et al. 2004, p. 156).

Larval Host Plants

For most butterfly species, larvae feed on plants within a single family (Scott 1986, p. 64). Some butterfly species are highly specialized and feed on only a single plant species or a few closely related species. Female Taylor's checkerspot butterflies and their larvae use plants that contain defensive chemicals known as iridoid glycosides, which have been recognized to influence the selection of oviposition sites by adult nymphalid butterflies (butterflies in the family Nymphalidae) (Murphy et al. 2004, p. 22; Page et al. 2009, p. 2), and function as a feeding stimulant for some checkerspot larvae (Kuussaari et al. 2004, p. 147). As maturing larvae feed, they accumulate these defensive chemical compounds from their larval host plants into their bodies. According to the work of Bowers (1981, pp. 373–374), this accumulation appears to deter predation. These larval host plants include members of the Broomrape family (Orobanchaceae), such as *Castilleja* (paintbrushes) and *Orthocarpus*, which is now known as *Triphysaria* (owl's clover), and native and nonnative *Plantago* species, which are members of the Plantain family (Plantaginaceae) (Pyle 2002, p. 311).

Taylor's checkerspot butterfly larvae have been confirmed feeding on *Plantago lanceolata* (narrow-leaf plantain) and *P. maritima* (sea plantain) in British Columbia (Guppy and Shepard

2001, p. 311), narrow-leaf plantain and *Castilleja hispida* (harsh paintbrush) in Washington (Char and Boersma 1995, p. 29; Pyle 2002, p. 311; Severns and Grosboll 2011, p. 4), and exclusively on narrow-leaf plantain in Oregon (Dornfeld 1980, p. 73; Severns and Warren 2008, p. 476). In 2012, the Taylor's checkerspot butterfly was documented preferentially ovipositing on the threatened *Castilleja levisecta* (golden paintbrush) in studies conducted in Washington, and in 2013, *Castilleja levisecta* was subsequently observed being utilized as a larval host plant in both Washington and Oregon (Kaye 2013, Aubrey 2013, in litt). The recent rediscovery in 2005 of Taylor's checkerspot butterflies in Canada led to the observation that additional food plants (*Veronica serpyllifolia* (thymeleaf speedwell) and *V. beccabunga ssp. americana* (American speedwell)) were being used by Taylor's checkerspot butterfly larvae (Page et al. 2009, p. 2).

Oviposition choices made by females determine which individual plant and which plant species prediapause larvae will feed upon. It is important to distinguish between pre- and post-diapause host plants when considering Taylor's checkerspot conservation because oviposition has only been observed to occur on three plant species in Oregon and Washington (*P. lanceolate, C. hispida, and C. levisecta*), whereas post-diapause larvae have been documented to eat *C. hispida,C. levisecta, P. lanceolata, Plectritis congesta* (sea blush), *Collinsia parviflora* (small-flowered blue-eyed Mary), *Triphysaria pusilla* (dwarf owl-clover), and *Symphoricarpos albus* (snowberry) (Severns and Grosboll 2011, p. 71). Other larval food plants documented in Washington include *Collinsia grandiflora* (large-flowered blue-eyed Mary) and *Orthocarpus attenuatus* (narrow-leaved owl-clover) (Stinson 2005, p. 88).

A recent body of work evaluated several multi-trophic and host-parasite questions related to Taylor's checkerspot butterflies, *P. lanceolata*, *C. hispida*, *C. levisecta*, and other plants in hemiparasitic relationships with those plants (Hann 2017). Hann (2017, p. 5-6) found that the host plant used, and plants in hemiparasitic relationships with that host plant, had a strong influence on larval mass, growth rate, survival, and secondary chemical sequestration. Hann's work also suggested that *C. levisecta* may have disadvantages as a larval host plant (2017, p. 140-141).

<u>Adult Nectar Sources</u>

Adult butterflies do not grow, but feeding is required to maintain activity and egg development. In general, adult butterflies are less specialized in their use of food plants than larvae, and can meet their needs in the general vicinity of the larval food plants. Total egg production in checkerspots is affected by the availability of nectar sources and can double when nectar is plentiful (Murphy 1983, p. 261). Taylor's checkerspots may be somewhat specialized on certain nectar sources, and the number of nectar sources is limited during their spring flight period. Adult nectar sources for feeding include several species found as part of the native (and one nonnative) species mix on northwest grasslands, including, but not limited to: *Balsamorhiza deltoidea* (Puget balsam root); *Eriophyllum lanatum* (Oregon sunshine); *Lomatium utriclatum* (fine-leaved desert parsley or spring gold); *Lomatium triternatum* (Nineleaf biscuitroot); *Camassia quamash* (common camas); *Cerastium arvense* (field chickweed); and wild strawberry (*Fragaria virginiana*) (Stinson 2005, p. 91).

Significance of Habitat Diversity

Landscape and habitat diversity, or heterogeneity, are essential elements for the conservation of Edith's checkerspot butterflies (Ehrlich and Murphy 1987, p. 122; Hellman et al. 2004, p. 41). Patches of habitat where Taylor's checkerspot butterfly populations are robust also tend to have high topographic diversity including areas with mima mounds (low, domelike, mounds of earth found in certain prairies) and areas composed of swales (depressions) that produce ecotone habitat (Johnson and O'Neil 2001, p. 715) between dry upland habitat typical of south Puget Sound prairies, and wet prairie habitat more typical of the Willamette Valley (Easterly et al. 2005, p. 1). Habitat diversity is important for species persistence at a site, because during drought, butterflies survive best in cool, moist habitats, during extremely wet periods, butterflies persist best on warm, dry exposures (Murphy et al. 2004, p. 32).

Dispersal and Colonization

Taylor's checkerspot butterflies are non-migratory, but some limited dispersal of adult butterflies away from their natal sites does occur, potentially allowing for the colonization of adjacent habitat patches, or genetic exchange between local populations (Singer and Hanski 2004, pp. 184-185) In general, dispersal movements in checkerspots have rarely been found to exceed 2–3 km (Wahlberg et al. 2004, p. 223). Mark-recapture studies with checkerspot butterflies in Finland documented that they generally flew less than 1,640 ft (500 m), and studies of dispersal indicates that 95 percent of colonizations have been within 2.3 km of the nearest source, and the longest recorded colonizations were within 4 to 5 km of source populations (Singer and Hanski 2004, p. 184). Research conducted in California on Edith's checkerspot butterflies indicate the species is relatively sedentary, with over 96 percent of individuals marked recaptured in the area of previous capture; and dispersal of individuals between closely situated populations (less than 1 km) is rare even though the occupied patches were well within potential dispersal distance for the species (Hellmann et al. 2004, pp. 39-40).

Little work has been carried out on the ability of the Taylor's checkerspot butterfly to disperse. However, a mark-recapture study conducted in Oregon showed that dispersal distance was short (less than 984 ft (300 m) (Kaye et al. 2011, p. 16) and that Taylor's checkerspot butterflies tended to move to the nearest open patch, or from poor resource patches to rich resource patches, although rates of recapture were low (Kaye et al. 2011, p. 12). The recent observation of a single Taylor's checkerspot on Vancouver Island, approximately 5 km distant from the nearest known population on Denman island likely represents a potential within-year long-distance dispersal for this species (Page et al. 2009, p. 18). Based on these various studies, we consider the typical dispersal distance for Taylor's checkerspot between habitat patches to be approximately 500 m (77 FR 61977), with the recognition that longer distance movements (up to 5 km) can occur in some years. This is consistent with research on other checkerspot species, which have described maximum colonization distances of 4-5 km for *E. e. bayensis* (Hellmann et al. 2004, p. 59).

Distribution and Status of Populations

The Taylor's checkerspot butterfly was historically known to occur in British Columbia, Washington, and Oregon, and its current distribution represents a reduction from over 80 locations rangewide to 15 sites in 2017. Historically, the Taylor's checkerspot butterfly was likely distributed throughout grassland habitat found on prairies, balds, grassland bluffs, and grassland openings within a forested matrix on south Vancouver Island, the northern Olympic Peninsula, the south Puget Sound prairies, and the Willamette Valley.

Nearly all localities for the Taylor's checkerspot butterfly in British Columbia have been lost; the only location currently known from British Columbia was discovered in 2005 (COSEWIC 2011, p. iv). In Oregon, the number of locations occupied by Taylor's checkerspot butterflies has declined from 13 to 2 (Ross 2011, *in litt.*, p. 1). In Washington State, 43 historical locales were documented for the Taylor's checkerspot butterfly. In 2017, there were 12 documented locations for the Taylor's checkerspot butterflies in Washington, with three localities consistently harboring more than 1,000 individuals, and the majority of known sites have daily counts of fewer than 100 individual butterflies.

Total population sizes for Taylor's checkerspot butterfly are unknown, as this type of information requires intensive monitoring using mark-recapture techniques. Because butterfly populations vary so much year-to-year, and are very difficult to estimate accurately without intrusive techniques, no population estimate has been attempted. Current information on relative population sizes are derived from day counts which reflect only a portion of the total population during any given flight season.

Based on historical and current data, the distribution and abundance of Taylor's checkerspot butterflies have declined significantly rangewide, with the majority of recent extirpations occurring from approximately the mid-1990s in Canada (COSEWIC 2011, p. 15), 1999–2004 in south Puget Sound prairies, and around 2007 at the Bald Hills location in Washington. At the time of listing, there were 14 individual locations that were considered occupied by the Taylor's checkerspot butterfly rangewide, distributed in four disjunct geographic areas: Denman Island (BC) (1 occupied site), North Olympic Peninsula (WA) (6 occupied sites), South Puget Prairies (WA) (5 occupied sites), and the Willamette Valley (OR) (2 occupied sites) (Table 1). As of April 2017, there were 15 individual locations considered occupied by Taylor's checkerspot butterfly rangewide, because of the 2014 reintroduction into Training Area 7 South on JBLM (Linders et al. 2014, p. 19). However, the population at 13th Division Prairie has declined and is now known only from infrequent unconfirmed sightings (Linders et al. 2016, p. 36). The Taylor's checkerspot butterfly is a declining taxon found only on a few habitat patches throughout the subspecies' range.

The distances between each of these disjunct geographic areas is great enough that there is no potential for connectivity or genetic exchange between these distant populations. Populations at each of the occupied sites face ongoing threats of habitat loss and degradation associated with succession and invasive nonnative plants, and other factors (see *Threats* discussion, below). A number of sites in Oregon and Washington where Taylor's checkerspot butterfly have been recently extirpated are considered high priority sites for habitat restoration and reintroduction of the species. These sites, which were unoccupied at the time the species was listed, are identified in the October 11, 2012 proposed rule to designate critical habitat for the Taylor's checkerspot butterfly (77 FR 61938).

Table 1. Summary of extant Taylor's checkerspot butterfly populations at the time of Federal listing in October 2013.

Region	Site	Approximate habitat area[1] (acres)	Potential estimated population size[2]	Distance to nearest occupied site (miles)[3]	Sources
BC	Denman Island	2,000+	1,000 - 10,000+	200+	COSEWIC 2011
WA – Olympic Peninsula	Sequim	151 (5 acres occupied)	50-500+	10.5	Severns & Grosboll 201l, Hays 2011
	Dan Kelly Ridge	209	50-100+	1.6	
	Eden Valley	26	50-100+	1.6	
	Upper Dungeness	93	50-100+	1.2	Holtrop 2010
	Three O'clock Ridge	103	50-100+	1.2	
	Bear Mountain	3	50-100+	3.9	
WA – South Puget Prairies	91st Division Prairie (East) (Range 72-76)	980	1,000 – 10,000+	2	Linders & Lewis 2013
	91st Division Prairie (West) (Range 50-51)	397	Reintroduced (2009-2011) 1,000-2,000+	2	
	13th Division Prairie (Training Area 15 and Pacemaker)	674	Reintroduced (2009, 2012) 0-50	8	
	Scatter Creek (South unit)	399	Reintroduced (2009-2013) 100-200+	2.1	
	Glacial Heritage	545	Reintroduced (2012-2013) 100 – 200+	2.1	
OR – Willamette Valley	Beazell Memorial Forest (5 sites)	61	200 – 800+	4.3	Ross 2012
	Fitton Green (4 sites)	83	500 – 1,000+	4.3	

Footnotes:

1. Approximate habitat area is a gross estimate based on areas mapped as proposed critical habitat for the Taylor's checkerspot butterfly (77 FR 61983) and includes areas that are not currently suitable habitat (i.e, areas occupied by trees and shrubs, etc.). Denman Island habitat area is from COSEWIC 2011, p. 15.
2. Actual population sizes for the Taylor's checkerspot butterfly are unknown, and can fluctuate considerably from year to year. Estimates listed here are considered to be general in nature and represent the cumulative total of adult butterflies on a site over the entire flight season. These estimates provide only a relative index of adult butterfly abundance based on multiple day counts or other monitoring surveys completed from 2008-2013.
3. Typical dispersal distances for checkerspot butterflies are generally considered to be less than or equal to 0.3 mile (less than or equal to 0.5 km)(77 FR 61977). Maximum known dispersal distance for Taylor's checkerspot are estimated at less than or equal to 3.1 miles (less than or equal to 5 km)(Page et al. 2009, p. 18).

Population Dynamics

Checkerspot butterfly populations can fluctuate widely from year to year primarily due to the complex interactions of host plant phenology, annual weather conditions, and local topography (McLaughlin et al., 2002, p. 538, Hellmann et al., 2004, p. 41). Some Taylor's checkerspot butterfly populations in Washington have exhibited boom years with several thousand individuals and then declined dramatically with only 100 or so butterflies remaining the following year (Stinson 2005, p. 85). Long-term monitoring of checkerspot populations has revealed that population dynamics in *E. editha* are driven by both density-dependent factors (e.g., host plant availability) and density-independent factors (e.g., weather and topography) and that the response of local butterfly populations to the same weather conditions is highly variable depending on site topography and habitat conditions (McLaughlin et al., 2002, p. 538). Local topography is important, as minor variations in aspect and moisture directly influence development of larvae and pupae, as well as host plant development (Hellmann et al. 2004, p. 47).

Female checkerspots lay a large number of eggs, which represents a great potential for population growth, but in most populations and in most years, nearly all larvae die before reaching the adult stage due to the effects of weather and the availability and quality of host plants (Hellman et al 2004, p. 41). Population dynamics for the Taylor's checkerspot have not been studied, but probably have similarities to that of the bay checkerspot (*E.e. bayensis*). Bay checkerspot populations fluctuate widely in size from year to year, often due to pre-diapause mortality rates that can be in excess of 90 percent (Kuussaari et al. 2004, p. 149). Egg to adult survival in Taylor's checkerspot populations is unknown, but may be similar to that of bay checkerspots which is estimated to be 1 to 5 percent per year (Moore 1989, p. 1735).

Population survival for checkerspots depends on the production of large numbers of larvae, so that some larvae survive to maturity. Drought affects populations by reducing the period of host plant availability, while extended periods of rain reduces reproduction, egg survival, and larval growth (Hellmann et al. 2004, p. 44). Pre-diapause mortality strongly affects adult abundance in the subsequent year (McLaughlin et al., 2002, p. 538). Climate and topography also affect growth of post-diapause larvae in the winter, when aspect-determined contrasts in solar exposure are greatest and weather patterns strongly influence post-diapause larval development (McLaughlin et al., 2002, p. 539).

The availability and quality of larval host plants is an important factor affecting larval survival. Larval survival can vary depending on the host plant species used, the host plant's hemiparasitic relationships, and the relative nutritional value of the host plant species (including secondary chemicals) (Moore 1989, p. 1735) (Haan 2017, p. 5-6). Populations with more than one potential host plant species available for use may be more likely to persist during adverse conditions (Hanski et al 2004, p. 270). Larvae are able to disperse between host plants and may shift use from one host species to another depending on the availability and senescence of host plant species (Hellmann et al. 2004, p. 43). Larval mortality from starvation can also occur due to competition when large numbers of larvae defoliate the available host plants (Kuussaari et al. 2004, p. 149). Predation and parasitism can be important sources of mortality in some butterfly species. However, there is no evidence that predation or parasitism is a significant source of larval mortality in *E. editha* (Kuussaari et al. 2004, p. 149).

Metapopulations

A metapopulation is a set of local populations that are connected over time by migration of individuals through dispersal and colonization (Nieminen et al. 2004, p. 64). Taylor's checkerspot butterfly most likely exhibited and persisted as a series of metapopulations composed of large and small local populations that interacted within a larger landscape context, with periodic extinction and colonization events. Most checkerspots are relatively sedentary and only a small percentage of individuals migrate to another habitat patch in any given year (Singer and Hanski 2004, p. 184). Colonization of empty patches may not occur in most years, but can occur in response to either very high or very low densities of butterflies within a habitat patch (Singer and Hanski 2004, pp. 189-190). Where there are other suitable habitat patches within dispersal distance, a vacant patch may become occupied, or genetic exchange between closely situated local populations may occur.

In *E. editha*, metapopulation dynamics are largely dependant on a few larger populations that act as sources of migrants to colonize habitat patches in the surrounding landscape (Hellman et al. 2004, p. 59). Not all habitat patches are occupied simultaneously, but in order for a metapopulation to persist over time, there is a balance between local extinctions and recolonizations. The conservation of butterfly species requires the protection of minimum viable metapopulations that include key source populations as well as smaller populations that allow the re-colonization of vacant patches to continue (Murphy and Weiss 1988, p. 183, Harrison 1989, p. 1242). Population modeling for other checkerspot species indicate a theoretical threshold of 15-20 well-connected habitat patches are necessary for long-term survival of a metapopulation (Hanski et al. 1996, pp. 539, Baguette and Schickzelle 2003, p. 410).

It is important to recognize that the total abundance and number of sites occupied by Taylor's checkerspot has been steadily declining over time. Habitat loss due to development, invasive plants, and natural succession has increased the isolation between occupied sites. The recent losses of multiple local populations due to stochastic extirpations has resulted in the loss of entire metapopulations (e.g., Bald Hills and south Puget Prairies in the vicinity of Rochester/Tenino, WA). The remaining extant populations of Taylor's checkerspot represent a relict distribution that is well below minimum habitat thresholds for long-term persistence. Management intervention is required to maintain and restore occupied habitat, and reintroduction efforts are needed to re-establish occupancy in habitats where metapopulations have been lost to local extinctions (Schultz et al. 2011, p. 374). Without metapopulation structure, the Taylor's checkerspot butterfly will likely continue to decline and may become extirpated at several of the locations where it currently is found (78 FR 61461).

Extinction Risk and Minimum Viable Populations

Most checkerspots live in small local populations. Small populations are influenced by several types of stochastic processes which can be grouped into environmental, demographic, and genetic processes (Whalberg et al 2004, p. 222). Checkerspots are highly vulnerable to perturbations in weather patterns, and populations can decline dramatically after years of extreme weather (hot and dry or cold and wet) because these extremes reduce reproductive success and larval survival (Hellmann et al. 2004, p. 51). Demographic factors can also lead to population declines due to competition for host plants at sites with high densities of larvae (Kuussarri et al. 2004, p. 159), or genetic factors associated with inbreeding depression in very small populations (Nieminen et al. 2001, p. 243).

Stochastic extirpations are often related to patch size and isolation (Thomas et al. 1992, p. 563, Hanski et al. 1995, p. 25), and habitat-driven extinctions are often due to successional changes causing the habitat to become unsuitable (Thomas 1994, p. 373). The extirpations of local *E.e. bayensis* populations have ultimately been traced to successive years of adverse weather coupled with isolation and habitat loss in the surrounding area that precluded colonization from adjacent populations (Hellmann et al. 2004, p. 58). The population monitoring data for the bay checkerspot demonstrate that even sites that consistently support populations of 1,000 to 10,000 butterflies can decline rapidly to extirpation within a matter of a few years due to environmental stochasticity (McLaughlin et al. 2002, p. 542).

The total abundance and number of sites occupied by *E.e. taylori* has declined steadily over the past several decades, with observed local extirpations at multiple sites documented from the mid 1990's to present (Stinson 2005, pp. 93-96). Habitat loss, habitat degradation, and loss of metapopulation structure has reduced local populations of Taylor's checkerspot to such low levels that they have become highly vulnerable to local extirpation. Population dynamics for Taylor's checkerspot have not been modelled, and information concerning the size of and trend of extant populations is only available for some sites. The limited information available suggests that most extant local populations likely consist of less than 1,000 individuals in most years, indicating the remaining Taylor's checkerspot populations are at high risk for stochastic extirpation. Estimates of minimum viable population size for Taylor's checkerspot have not been developed, but are likely comparable to other sedantary butterfly species, which indicate that in order for metapopulations to persist over the long-term (greater than 100 years), each metapopulation should consist of 10 to 20 well connected habitat patches, supporting minimum metapopulations of 1,000's of butterflies (Hanski et al. 1996, p. 539; Bergman and Kindvall 2004, p. 57, Schiktzelle 2005, p. 578). Most of the remaining Taylor's checkerspot populations do not currently meet these theoretical criteria for metapopulation viability.

Threats

<u>Habitat Loss and Fragmentation Associated with Land Conversion</u>

The primary long-term threat to the Taylor's checkerspot butterfly is the loss, conversion, and degradation of habitat, particularly as a consequence of agricultural and urban development, successional changes to grassland habitat, and the spread of invasive plants.

Prairies, which historically covered over 145,000 acres (60,000 ha) of the south Puget Sound region, have largely been lost over the past 150 years (Crawford and Hall 1997, p. 11). The primary causes of prairie habitat loss in the region are attributed to the conversion of prairie habitat to urban development and agricultural uses (over 60 percent of losses), and succession to Douglas-fir forest (32 percent) (Crawford and Hall 1997, p. 11). Today approximately 8 percent of the original prairies in the south Puget Sound area remain, but only about 3 percent contain native prairie vegetation (Crawford and Hall 1997, p.11). In the remaining prairies, many of the native bunchgrass communities have been replaced by nonnative pasture grasses (Rogers 2000, p. 41). In the Willamette Valley, Oregon, native grassland has been reduced from the most common vegetation type to scattered parcels intermingled with rural residential development and farmland; it is estimated that less than 1 percent of the native grassland and savanna remains in Oregon (Altman et al. 2001, p. 261).

Native prairies and grasslands have been severely reduced throughout the range of the Taylor's checkerspot butterfly as a result of human activity due to conversion of habitat to residential and commercial development and agriculture. Prairie habitat continues to be lost, particularly to residential development (Stinson 2005, p. 70) by removal of native vegetation and the excavation and grading of surfaces and conversion to non-habitat (buildings, pavement, other infrastructure). Residential development is associated with increased infrastructure such as new road construction, which is one of the primary causes of landscape fragmentation (Watts et al. 2007, p. 736). Activities that accompany low-density development are correlated with decreased levels of biodiversity, mortality to wildlife, and facilitated introduction of nonnative, invasive species (Trombulak and Frissell 2000, entire; Watts et al. 2007, p. 736). Four historical locales for Taylor's checkerspot butterflies in the south Puget Sound region were lost to development or conversion. Dupont, Spanaway, and Lakewood were all converted to urban areas, and Joint Base Lewis McChord (JBLM) Training Area 7S became a gravel pit (Stinson 2005, pp. 93–96).

The decline in native grassland habitats is exemplified by the reduction in the distribution of the Taylor's checkerspot butterfly from 43 historic populations to 11 populations in Washington, from 13 historic populations to 2 populations in Oregon, and from 24 historic populations to 1 population known from Canada (78 FR 61480). Most sites with extant populations of Taylor's checkerspot butterfly are protected from further development through either state, Federal, or local conservation ownership, but habitats at many of these sites are further degraded by invasive species and competing uses such as recreation or military training (Schultz et al. 2011, p. 370).

As prairie habitat has been lost to urban development and agricultural conversion, the resulting fragmentation of remnant prairie habitat has led to a significant reduction in total prairie area, patch size and potential connectivity between habitat patches. Because of this, sites where Taylor's checkerspot have been locally extirpated are unlikely to be re-colonized given their isolation from any source population (Schultz et al. 2011, p. 371). The historic metapopulation dynamics that linked various local populations of the Taylors checkerspot butterfly have been lost due to the fragmentation and isolation of remnant prairie patches, leaving the subspecies at high risk of extirpation due to habitat factors, weather extremes, increased mortality due to human impacts, and inbreeding (Stinson 2005, p. 100).

<u>Loss of Ecological Disturbance Processes, Invasive Species, and Succession</u>

The suppression and loss of natural and anthropogenic disturbance regimes, such as fire, across vast portions of the landscape has resulted in altered vegetation structure in the prairies and meadows and has facilitated invasion by nonnative grasses and woody vegetation, rendering habitat unusable for Taylor's checkerspot butterflies. Historically, the prairies and meadows of the south Puget Sound region of Washington and western Oregon are thought to have been actively maintained by the native peoples of the region, who lived there for at least 10,000 years before the arrival of Euro-American settlers (Boyd 1986, entire; Christy and Alverson 2011, p. 93). Frequent burning reduced the encroachment and spread of shrubs and trees (Boyd 1986, entire; Chappell and Kagan 2001, p. 42; Storm and Shebitz 2006, p. 264), favoring open grasslands with a rich variety of native plants and animals. The basic ecological processes that maintain prairies or meadows have disappeared from, or have been altered on, all but a few protected and managed sites. At JBLM, approximately 39 percent (over 16,200 acres [6560 ha]) of the original prairie habitat has transitioned to Douglas-fir forest, and only a fraction of the original prairie habitat remains as small, isolated prairies (Tveten 1997, p. 124, Foster and Shaff 2003, p. 283).

Fires on the prairie create a mosaic of vegetation conditions, which serve to maintain native prairie forbs like *Camassia quamash* (common camas), *Achillea millefolium* (yarrow), and *Lomatium* spp. (desert parsley or biscuit root), which are adult nectar foods for the Taylor's checkerspot butterfly. Stands of native perennial grasses (*Festuca idahoensis* ssp. *roemeri* (Roemer's fescue)) are also well adapted to regular fires and produce habitat favorable to the Taylor's checkerspot butterfly. In some prairie patches, fires will reset succession back to bare ground, creating early successional vegetation conditions suitable for Taylor's checkerspot butterflies (Pearson and Altman 2005, p. 13). The historical fire return frequency on prairies has been estimated to be 3 to 5 years (Foster 2005, p. 8).

The result of fire suppression has been the invasion of the prairies and oak woodlands by native and nonnative plant species (Dunn and Ewing 1997, p. v; Tveten and Fonda 1999, p. 146), notably woody plants such as the native Douglas-fir (*Pseudotsuga menziesii*) and the nonnative Scot's broom, and nonnative grasses such as *Arrhenatherum elatius* (tall oatgrass) in Washington and *Brachypodium sylvaticum* (false brome) in the Willamette Valley of Oregon. This increase in woody vegetation and nonnative plant species has resulted in less available prairie habitat overall, and habitat that is avoided by Taylor's checkerspot butterflies (Tveten and Fonda 1999, p. 155). Where controlled burns or direct tree removal are not used as a management tool, this encroachment will continue to cause the loss of open grassland habitats for the Taylor's checkerspot butterfly.

Unintentional fires ignited by military training burns patches of prairie grasses and forbs on JBLM on an annual basis. These light ground fires create a mosaic of conditions within the grassland, maintaining a low vegetative structure of native and nonnative plant composition, and patches of bare soil. On sites where regular fires occur, such as on JBLM, there is a high complement of native plants and fewer invasive species, and a higher percentage of bare soil. These types of fires promote the maintenance of the native, short-statured vegetation communities (Severns and Warren 2008, p. 476) favored by the Taylor's checkerspot butterflies for larval and nectar food resources. Fire management to maintain or restore native vegetation is essential to maintaining suitable habitat for the Taylor's checkerspot butterfly, but requires careful planning and implementation because prescribed fire can destroy larvae, eggs, or adult butterflies when occupied habitats are burned.

Bald habitat at National Forest and Washington State Department of Natural Resources sites where Taylor's checkerspot butterflies are found were created due to shallow soil conditions, and some may have been formerly forested and recently harvested, which resulted in early seral vegetation conditions suitable for Taylor's checkerspot. On bald habitat that was formerly forested, these areas appear to have been colonized by the Taylor's checkerspot butterfly shortly after they were cleared. At the time the trees were harvested from each of these balds they were replanted with conifers. The establishment and growth of the conifers, and the establishment and expansion of *Acer macrophyllum* (bigleaf maple), *Holodiscus discolor* (oceanspray), and other shrubs has resulted in shaded habitat that has replaced habitat occupied by the Taylor's checkerspot butterfly. Management of these balds should continue to focus on removing shade-forming trees and shrubs coupled with active management to revegetate native forbs.

Sites that currently have Taylor's checkerspot butterflies present will quickly become unsuitable if trees and shrubs are not removed and if the sites are not managed specifically for the long-term conservation of the Taylor's checkerspot butterfly or the maintenance of bald habitat. This is the case for several balds recently occupied by the Taylor's checkerspot butterfly but no longer supporting the subspecies, including Bald Hills NAP in Thurston County of south Puget Sound, and Highway 112 and Striped Peak in Clallam County, on the north Olympic Peninsula.

<u>Military Training and Associated Activities</u>

JBLM contains the largest patches of remnant prairie habitat remaining in the south Puget Sound region (Stinson 2005, p. 11), and also contains the only remaining native population of Taylor's checkerspot butterfly on Puget prairie habitat. Frequent, low-intensity fires on the 91st Division Prairie on JBLM have maintained large areas of relatively high-quality prairie habitat (Stinson 2005, p. 12), and active prairie restoration and habitat maintenance programs on JBLM have facilitated recent reintroduction efforts both on and off JBLM. However, ongoing military training activities on JBLM has resulted in direct mortality of Taylor's checkerspot butterflies and the destruction of Taylor's checkerspot butterfly habitat through road construction, land conversion, and other developments. Off-road vehicle use, training with explosives, and soldier foot traffic in occupied habitat can kill butterfly eggs, larvae, and adults, and destroy larval host plants. These actions disrupt intact prairie plant communities by disturbing the vegetation and exposing soils, directly introducing invasive plant seeds carried in on tires or boots, and accelerating the rate of establishment of invasive grasses or other nonnative plants. The Department of Defense and the Service completed ESA Section 7 consultation on a 5-year program of routine military training, maintenance, recreation, and resource management activities in January of 2017 (FWS Ref. No. 01EWFW00-2014-F-0430).

Several Department of Defense policies and an Integrated Natural Resources Management Plans (INRMP) are in place on JBLM in addition to the biological opinion to provide conservation measures to reduce the impacts of training activities to habitat occupied by Taylor's checkerspot. JBLM's INRMP includes provisions that will promote protection and conservation practices to support the Taylor's checkerspot butterfly, and to prevent further population declines associated with habitat loss or inappropriate management on JBLM properties. Despite these conservation measures, military training continues to have significant, habitat-altering impacts on the Taylor's checkerspot butterfly. All training areas on JBLM that are currently occupied by Taylor's checkerspot butterflies experience regular training, including mounted vehicle training and infantry training, with foot soldiers directly impacting the area where the subspecies is found. The U.S. Fish and Wildlife Service has worked closely with the Department of Defense to develop protection areas within the primary habitat for the Taylor's checkerspot butterfly on JBLM. These include areas where no vehicles are permitted on occupied habitat, where vehicles will remain on roads only, and where foot traffic is allowed. These conservation measures are important for reducing the impacts of the training activities, but these activities will continue to harm individuals as described in the biological opinion.

The Department of Defense and the U.S. Fish and Wildlife Service signed a Memorandum of Understanding in July 2015 stating that the two parties would enhance the Army Compatible Use Buffer Program and support the missions of both parties by creating a mechanism whereby protecting and managing lands for listed species will allow on-base training flexibility. As of April 2017, the crediting and debiting agreement is in development and the DOD had not yet submitted a biological assessment for consultation describing the scope of the regulatory relief requested and the mitigation efforts being proposed. When implemented, this agreement should increase the number and robustness of Taylor's checkerspot butterfly populations in the range of the species but decrease and/or change the role of habitat on Joint Base Lewis-McChord for supporting the recovery of the species.

Habitat Management and Restoration

The ongoing threat of habitat loss and degradation associated with succession and the presence of nonnative invasive plants requires active management of prairie and grassland habitat in order for the Taylor's checkerspot butterfly to persist. Restoration activities are recognized as necessary and beneficial for the long-term persistence of the subspecies, but restoration activities must be carefully planned and implemented to minimize impacts to extant populations (Schultz et al. 2011, p. 375). On occupied sites, Taylor's checkerspot butterflies are present throughout the year in some life cycle form. Restoration activities (application of herbicides, use of restoration equipment, and prescribed fire) can result in trampling, crushing, and destruction of Taylor's checkerspot butterfly eggs, larvae, and adults, and the destruction of larval host plants.

Mowing is sometimes the only feasible alternative to prescribed fire. Mowing to reduce the cover and competition from woody species, especially if done at the wrong time of year, can crush larval host plants and nectar plants used by adult butterflies on a site or even crush and kill larvae. Mowing activities should be timed to coincide with the diapause period for the subspecies, and mowing should be relatively high above the soil level to avoid any larvae that may not have burrowed into the soil. Restoration actions to improve Taylors' checkerspot butterfly habitat or increase the number of checkerspots on specific prairie patches is likely to have short-term adverse impacts to individuals. However, with careful planning and implementation, impacts to local populatons can be minimized and allow for successful reintroduction efforts or the expansion of occupied habitats.

Pesticides and Herbicides

In the south Puget Sound region, currently occupied Taylor's checkerspot butterfly sites are found in a matrix of rural agricultural lands and low-density development. In this context, herbicide and insecticide use may have direct effects on nontarget plants (butterfly larval and nectar hosts) and butterflies (Stark et al. 2012, p. 23). Herbicides are commonly used to manage rare butterfly habitat and control invasive nonnative plants in south Puget Sound prairies (Schultz et al. 2011, p. 373). Herbicide use can affect butterflies by damaging or destroying larval or adult food sources, or through the direct ingestion of a toxic substance, resulting in reduced larval survival and decreased rates of development from larvae to adult, as well as decreased wing area in some species of butterflies (Russell and Schultz 2010, p. 53). These studies indicate that the direct application of herbicide onto eggs, larvae, and larval host plants can result in reduced rates of larva-to-adult survival in some butterfly species, emphasizing the need for careful management using selective applications in habitats occupied by Taylor's checkerspot butterflies.

Aerial applications of pesticide also pose a potential threat to Taylor's checkerspot. The lepidopteran-specific insecticide, *Bacillus thurengensis var. kurstaki* (Btk) has been aerially applied to control Asian gypsy moth (*Lymantria dispar*) in the Puget Sound region and likely contributed to the extirpation of three historical locales for Taylor's checkerspot butterflies in Pierce County, Washington, in 1992 (Vaughan and Black 2002, p. 13). Although grasslands are not targeted for Btk applications, drift from aerial applications can be lethal to non-target butterflies up to 1.8 miles (3 km) away from the target area (Whaley et al. 1998, p.539). Severns (2002) sampled butterfly diversity, richness, and abundance (density) for two years following a Btk application at Schwarz Park in Lane County, Oregon. Diversity, richness, and density were found to be significantly reduced for 2 years following spraying of Btk (Severns 2002, p. 168). Species like Taylor's checkerspot butterflies, which have a single brood per year, are active in the spring and their larvae are active during the spray application period. For nontarget lepidoptera, the early instar stages of larvae are the most susceptible stage (Wagner and Miller 1995, p. 21). A widespread application of Btk could have substantial impact on a local butterfly population if the pesticide were sprayed in an area where the habitat is exposed to the pesticide from direct application or through aerial drift. In 2016, the U.S. Department of Agriculture and the Washington State Department of Agriculture coordinated with the U.S. Fish and Wildlife Service before an aerial application of Btk to control gyspy moths at sites across western Washington, including the south Puget Sound. Fortunately, the proposed areas for application were greater than 1.8 miles from any population of Taylor's checkerspot butterfly and no effects on the populations were expected. Future Btk treatments for gypsy moth control may not be so conveniently located.

<u>Recreation and Off-Road Vehicles</u>

Recreational foot traffic may be a threat to the Taylor's checkerspot butterfly, as trampling will crush larvae if they are present underfoot. For example, foot traffic is relatively common at Scatter Creek Wildlife Area in Washington, where plants and butterfly habitat have been trampled by horses during specialized dog competitions in which dogs are followed by observers on horseback (Stinson 2005, p. 6), and by foot traffic using the trail system to access the meadows of Beazell Memorial Forest (Park) in Oregon. Recreation by JBLM personnel and local individuals occurs on and near the 13th Division Prairie. Trampling by humans and horses, as well as people walking dogs on the 13th Division Prairie, is likely to crush some larvae, as well as the larval and nectar prairie plant communities that are restored and managed for in this area.

Larvae have potentially been crushed on Dan Kelly Ridge, on the north Olympic Peninsula by vehicles that access the site to maintain a cell tower on the ridge. Also, recreational off-road vehicle (ORV) traffic on Dan Kelly Ridge, and on Eden Valley, has damaged larval host plants. The ORV damage on Dan Kelly Ridge occurs despite efforts by Washington State Department of Natural Resources to block access into the upper portions of the road system through gating of the main road. Based on our review, we conclude that ground-disturbing recreational activities are a threat to the Taylor's checkerspot butterfly and where the population is depressed may constitute a serious threat to the long-term conservation of the subspecies.

Low Genetic Diversity, Small or Isolated Populations, and Low Reproductive Success

There are a number of studies that demonstrate that habitat patch size, local population size, and proximity to adjacent populations have important implications for the long-term persistence of butterfly populations with limited dispersal capabilities (e.g., Thomas and Jones, 1993, p. 472; Hanski et al. 1995, p. 618; Saccheri et al. 1998, p. 492; Maes et al. 2004, pp. 234-235). Studies that examined butterfly population dynamics generally define "small" populations as having fewer than 500 adults and "very small" as having fewer than 100 adults at peak emergence (e.g., Maes et al. 2004, p. 232; Davies et al. 2005, p. 192). All of the known populations of Taylor's Checkerspot butterfly except three in the south Puget Sound (two of which occur on the same prairie) are currently classified as small or very small populations.

Extremely small butterfly populations (e.g. fewer than 20 individuals) are not only highly vulnerable to environmental factors such as adverse weather conditions (Schtickzelle et al. 2005, p. 578), but such small populations are also at increased risk of extinction due to genetic effects associated with inbreeding (Saccheri et al. 1998, p. 491; Nieminen et al. 2001, p. 243). Inbreeding in small populations of the Glanville fritillary butterfly (*Melitaea cinxia*) resulted in reduced egg hatching rates, larval survival, and adult longevity (Nieminen et al. 2001, p. 243).

Taylor's checkerpot butterflies as a species are likely to have experienced a loss of genetic diversity as a result of geographic isolation and habitat fragmentation across the distribution of the existing populations. A recent study of nine remnant Taylor's checkerpot butterfly populations showed that there was strong evidence for five disjunct and genetically distinct groups within the current range of the species (Severns et al. 2013). Dispersal of individuals between local populations directly affects the genetic composition of populations and possibly the abundance of individuals in a population (Hellmann et al. 2004, p. 59). For other subspecies of Edith's checkerspot and their closely related European relative *Melitaea*, small populations led to a high rate of inbreeding (Boggs and Nieminen 2004, p. 98). Due to the Taylor's checkerspot small population size and fragmented distribution, we conclude that the negative factors associated with small populations, as well as the potential historical loss of genetic diversity, may contribute to further population declines for the Taylor's checkerspot butterfly.

Climate Change

Over the next century, climate change at global and regional scales is predicted to result in changes in butterfly species distributions and altered life histories (McLaughlin et al. 2002, p. 6074, Hill et al. 2002, p. 2163, Singer and Parmesan 2010, p. 3161). Rare butterflies, including the Taylor's checkerspot, may be vulnerable to climate change, as their populations are often fragmented due to habitat losses that restrict the species' ability to adapt to changing environmental conditions (Schultz et al. 2011, p. 375).

In the Pacific Northwest, mean annual temperatures rose 0.8 °C (1.5 °F) in the 20th century and are expected to continue to warm from 0.1 °C to 0.6 °C (0.2 °F to 1.0 °F) per decade (Mote and Salathe 2010, p.29). Global climate models project an increase of 1 to 2 percent in annual average precipitation, with some models predicting wetter autumns and winters with drier summers (Mote and Salathe 2010, p.29). Regional models of potential climate changes are much more variable, but the models generally indicate a warming trend in mean annual temperature, reduced snowpack, and increased frequency of extreme weather events (Salathe et al. 2010, pp. 72-73). Downscaled regional climate models, such as those presented by www.climatewizard.org have tremendous variation in projections for annual changes in temperature or precipitation depending upon the climate model or scenario. Averaged values across large areas generally indicate a general warming trend in mean annual temperature consistent with the climate projections reported by Salathe and others (2010, pp. 72-73).

Because the Taylor's checkerspot butterfly occupies a relatively small area of specialized habitat, it may be vulnerable to climatic changes that could decrease suitable habitat or alter food plant seasonal growth patterns (phenology). The relationship between climate change and survival for the *Euphydryas editha* complex is driven more by the indirect effects of the interaction between seasonal growth patterns of host plants and the life cycle of the checkerspot butterfly than by the direct effects of temperature and precipitation (Guppy and Fischer 2001, p. 11; Parmesan 2007, p. 1868; Singer and Parmesan 2010, p. 3170). Predicting seasonal growth patterns of butterfly host plants is complicated, because these patterns are likely more sensitive to moisture than temperature (Cushman et al. 1992, pp. 197–198; Bale et al. 2002, p. 11), which is predicted to be highly variable and uncertain in the Pacific Northwest (Mote and Salathé 2010, p. 31). Climate models for the Georgia Basin—Puget Sound Trough—Willamette Valley Ecoregion consistently predict a deviation from the historical monthly average precipitation, with the months of January through April projected to show an increase in precipitation across the region, while June through September are predicted to be much drier than the historical average (Climatewizard 2012).

It is likely that the overlap of seasonal growth patterns between primary larval host plants and the Taylor's checkerspot butterfly will display some level of stochasticity due to climatic shifts in precipitation and increased frequency of extreme weather events. For the Edith's checkerspot (*E. editha*), Parmesan (2007, p. 1869) reported that a lifecycle mismatch can cause a shortening of the time window available for larval feeding, causing the death of those individuals unable to complete their larval development within the shortened period, citing a study by Singer (1972, p. 75). In that study, Singer documented routine mortality of greater than 98 percent in the field due to phenological mismatches between larval development and senescence of their annual host plant *Plantago erecta* (California plantain). When mismatches such as these form the 'starting point,' insects may be highly vulnerable to small changes in synchrony with their hosts (Parmesan 2007, p. 1869).

The interplay between host plant distribution, larval and adult butterfly dispersal, and female choice of where to lay eggs will ultimately determine the population response to climate change (Singer and Parmesan 2010, p. 3164). However, determining the long-term responses to climate change from even well-studied butterflies in the genus *Euphydryas* is difficult, given their ability to switch to alternative larval food plants in some instances (Singer and Thomas 1996, pp. S33–34; Hellmann 2002, p. 933; Singer et al. 1992, pp. 17–18). Attempts to analyze the interplay between climate and host plant growth patterns using predictive models or general State-wide assessments and to relate these to the Taylor's checkerspot butterfly are equally complicated (Murphy and Weiss 1992, p. 8). Despite the potential for future climate change in Western Washington, we have not identified, nor are we aware of any data on an appropriate scale to evaluate the effects of climate change to habitat or population trends for the Taylor's checkerspot butterfly. However, we recognize that weather events and climatic factors strongly influence the reproduction and larval survival rates for the Taylor's checkerspot, and these effects are most profound in species with small, isolated populations such as the Taylor's checkerspot.

<u>Stochastic Weather Events</u>

Adverse weather (freezing temperatures, heavy rain events, or prolonged drought) can extirpate local butterfly populations by killing adults, larvae, or larval food plants (Guppy and Shephard 2001, p. 59). Even large populations of butterflies (greater than 5,000 individuals) can rapidly decline in response to successive seasons of unfavorable weather conditions during reproduction and larval development (Ehrlich et al. 1980, pp. 102-103). Poor weather conditions, such as cool temperatures and rainy weather, reduce the number of days in the flight period for several early spring flying butterflies, including the Taylor's checkerspot butterfly. A shorter flight season reduces the number of opportunities for oviposition (egg laying) for female butterflies, thus affecting the emergence of adult butterflies in the future.

Butterflies, including the Taylor's checkerspot butterfly, may experience increased mortality or reduced fecundity if the timing of plant development does not match the timing of larval or adult butterfly development (Peterson 1997, p. 167), and large fluctuations in population sizes have been observed based on local weather patterns (Hellmann et al. 2004, p. 45). During 2010 and 2011, the emergence of Taylor's checkerspot butterfly adults was approximately 3 weeks later than "normal" due to wet and cool spring weather. In addition, it has been reported that both drought and deluge may interrupt the insect-plant interaction, resulting in decreased populations (Hellmann et al. 2004, p. 45). The effects of drought have been shown to negatively affect populations of Edith checkerspot butterflies in California (Hellmann et al. 2004, p. 45).

Because the historical numbers and distribution of the Taylor's checkerspot butterfly has been reduced to a handful of relict populations, the subspecies is particularly vulnerable to the effects of adverse weather events, particulary when compounded with other ongoing threats associated with habitat loss and degradation associated with succession and invasive plants.

Conservation and Recovery Actions

The imperiled status of the Taylor's checkerspot butterfly has led to a number of habitat restoration actions and reintroduction efforts. The Washington Department of Fish and Wildlife in cooperation with the Oregon Zoo, the Mission Creek Womens Corrections Center for Women, and others have an ongoing captive rearing program to support reintroduction of Taylor's checkerspot butterflies at south Puget prairie sites that have been managed for butterfly habitat (e.g., Linders et al. 2016). Sites targeted for reintroduction include areas that historically supported Taylor's checkerspot butterfly. Reintroductions of captive-reared postdiapause larvae and adult butterflies have resulted in the tentative establishment of four Taylor's checkerspot populations since 2007 (Table 1, above, plus Training Area 7 South), while efforts at a fifth site (JBLM-Pacemaker) have been discontinued, and only scattered individual butterflies have been observed (Linders & Lewis 2016, p. 36).

Habitat restoration efforts to manage invasive species and restore native forb and grass communities is ongoing at most sites currently occupied by the Taylor's checkerspot butterfly (e.g., Linders & Lewis 2013, Hayes 2011, Ross 2008). In 2007, JBLM, started an Army Compatible Use Buffer (ACUB) initiative that includes support for interagency butterfly habitat management on several Puget prairie sites (Fimbel et al. 2011, p. 379). Habitat restoration using prescribed fire, herbicide applications, followed by seeding and planting of native grasses and forbs have proven to be successful methods for restoring degraded prairie habitats (Fimbel et al. 2011, p. 379). Removal of small trees and shrubs within natural balds and occupied clearcut areas on the Olympic Peninsula has been undertaken to slow the rate of natural succession occurring there, as these sites are undergoing rapid transition from grass to forested habitat (Hayes 2011, p. 10). Habitat restoration and maintenance is an ongoing conservation need at all sites currently occupied by Taylor's checkerspot butterfly, as native plant communities have largely been replaced by non-native grasses and invasive shrubs.

Summary of Species Status and Threats

The distribution of the Taylor's checkerspot butterfly has been reduced from more than 80 populations to the 15 occupied locations that are known rangewide today. Some of the populations that have been extirpated have disappeared in the past decade, and some declined from robust population sizes of 1,000s of individual butterflies to zero within a 3-year interval and have not returned (Stinson 2005, p. 94). In the south Puget prairies, only one native local population remains, others are the result of recent reintroduction efforts. Most remaining populations of Taylor's checkerspot butterflies are very small; approximately half of the 15 known populations are estimated to have fewer than 100 individuals.

The threats of land development and loss of habitat from conversion to other uses (agriculture); the impacts of military training and recreation; existing and likely future habitat fragmentation, habitat disturbance; long-term fire suppression; and ongoing loss and degradation of habitat associated with native and nonnative invasive species continues. These factors have resulted in the present isolation and limited distribution of the subspecies, and are currently ongoing and will continue into the foreseeable future. The combination of ongoing threats coupled with small population sizes and highly variable population dynamics leads us to conclude that the Taylor's checkerspot butterfly is currently in danger of extinction throughout its range.

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APPENDIX B
STATUS OF TAYLOR'S CHECKERSPOT CRITICAL HABITAT

Appendix B
Status of Taylor's Checkerspot Butterfly Critical Habitat

Legal Status

On October 3, 2013, the U.S. Fish and Wildlife Service designated critical habitat for the Taylor's checkerspot butterfly (*Euphydryas editha taylori*) under the Endangered Species Act of 1973, as amended (Act). The critical habitat designation includes three critical habitat units (CHUs) which encompass approximately 1,941 acres in Island, Clallam, and Thurston Counties in Washington; and in Benton County in Oregon (78 FR 61506-61589). The critical habitat designation within the three CHUs is further subdivided into 11 subunits (Table 1).

Critical habitat is defined in section 3 of the Act as: (1) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) Essential to the conservation of the species, and (b) Which may require special management considerations or protection; and (2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species (78 FR 61516).

The critical habitat designation for the Taylor's checkerspot butterfly includes areas that were occupied by the subspecies at the time of listing, and additional areas that were not occupied at the time of listing, but are considered essential for the long-term conservation and recovery of the species.

Primary Constituent Elements

Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of Taylor's checkerspot butterfly critical habitat consist of four components (78 FR 61576-61577):

i. Patches of early seral, short-statured, perennial bunchgrass plant communities composed of native grass and forb species in a diverse topographic landscape ranging in size from less than 1 acre up to 100 acres (0.4 to 40 ha) with little or no overstory forest vegetation that have areas of bare soil for basking that contain:

   a. In Washington and Oregon, common bunchgrass species found on northwest grasslands include *Festuca roemeri* (Roemer's fescue), *Danthonia californica* (California oat grass), *Koeleria cristata* (prairie Junegrass), *Elymus glaucus* (blue wild rye), *Agrostis scabra* (rough bentgrass), and on cooler, high-elevation sites typical of coastal bluffs and balds, *Festuca rubra* (red fescue).

   b. On moist grasslands found near the coast and in the Willamette Valley, there may be *Bromus sitchensis* (Sitka brome) and *Deschampsia cespitosa* (tufted hairgrass) in the mix of prairie grasses. Less abundant forbs found on the grasslands include, but are not limited to, *Trifolium* spp. (true clovers), narrow-leaved plantain (*Plantago lanceolata*), harsh paintbrush (*Castilleja hispida*), Puget balsamroot (*Balsamorhiza deltoidea*), woolly sunshine (*Eriophyllum lanatum*), nine-leaved desert parsley (*Lomatium triternatum*), fine-leaved desert parsley (*Lomatium utriculatum*), common camas (*Camassia quamash)*, showy fleabane (*Erigeron speciosus*), Canada thistle (*Cirsium arvense*), common yarrow (*Achillea millefolium*), prairie lupine (*Lupinus lepidus*), and sickle-keeled lupine (*Lupinus albicaulis*).

ii. Primary larval host plants (narrow-leaved plantain and harsh paintbrush) and at least one of the secondary annual larval host plants (blue-eyed Mary (*Collinsia parviflora*), sea blush (*Plectritis congesta)*, or dwarf owl-clover (*Triphysaria pusilla*) or one of several species of speedwell (marsh speedwell (*Veronica scutella*), American speedwell (*V. beccabunga* var. *americana*), or thymeleaf speedwell (*V. serpyllifolia*).

iii. Adult nectar sources for feeding that include several species found as part of the native (and one nonnative) species mix on northwest grasslands, including: narrow-leaved plantain; harsh paintbrush; Puget balsam root; woolly sunshine; nine-leaved desert parsley; fine-leaved desert parsley or spring gold; common camas; showy fleabane; Canada thistle; common yarrow; prairie lupine; sickle-keeled lupine; and wild strawberry (*Fragaria virginiana*).

iv. Aquatic features such as wetlands, springs, seeps, streams, ponds, lakes, and puddles that provide moisture during periods of drought, particularly late in the spring and early summer. These features can be permanent, seasonal, or ephemeral.

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, railroad tracks, and other paved areas) and the land on which they are located existing within the legal boundaries of the designated critical habitat (78 FR 61577).

Critical Habitat Designation

The three units designated as critical habitat are: Unit 1, South Sound—1,143 ac (462 ha) in Washington State, Unit 2, Strait of Juan de Fuca—779 ac (315 ha) in Washington State (160 ac (65 ha); and Unit 4, Willamette Valley—20 ac (8 ha) of privately owned lands in Oregon. The approximate area of each critical habitat unit and its relevant subunits, as well as land ownership within each unit, is shown in Table 1.

TABLE 1.—*Critical habitat units designated for Taylor's checkerspot butterfly.* Note: Area sizes may not sum due to rounding. Area estimates reflect all land within critical habitat unit boundaries.

Unit 1: South Sound		**Federal**	**State**	**County**	**Private**	**Other***	**Currently Occupied**
	Subunit Name	Ac (Ha)	Ac (Ha)	Ac (Ha)	Ac (Ha)	Ac (Ha)	Y/N
1-A	Rocky Prairie	0	0	0	0	43 (17)	N
1-B	Tenalquot Prairie	0	0	0	0	135 (55)	N
1-C	Glacial Heritage	0	0	545 (220)	0	0	Y
1-D	Rock Prairie	0	0	0	244 (99)	0	N
1-E	Bald Hill	0	0	0	176 (71)	0	N
	Unit 1 Totals	**0 (0)**	**0 (0)**	**545 (220)**	**420 (170)**	**178 (72)**	
Unit 2: Strait of Juan De Fuca		**Federal**	**State**	**County**	**Private**	**Other***	
2-A	Deception Pass State Park	0	149 (60)	0	0	0	N
2-B	Central Whidbey	0	39 (16)	0	0	190 (77)	N
2-C	Elwha	0	0	0	51 (20)	39 (16)	Y
2-D	Sequim	0	0	0	151 (61)	0	Y
2-E	Dungeness	160 (65)	0	0	0	0	Y
	Unit 2 Totals	**160 (65)**	**188 (76)**	**0**	**201 (81)**	**229 (93)**	
Unit 4: Willamette Valley		**Federal**	**State**	**County**	**Private**	**Other***	
4-D	Fitton Green-Cardwell Hill	0	0	0	20 (8)	0 (0)	Y
	Unit 4 Totals	**0**	**0**	**0**	**20 (8)**	**0 (0)**	
Grand Total – all Units		**160 (65)**	**188 (76)**	**545 (220)**	**642 (259)**	**407 (166)**	
GRAND TOTAL ALL UNITS, ALL OWNERSHIP		**1,941 (786)**					

*Other = Ports, local municipalities, and nonprofit conservation organizations.

Special Management Considerations or Protections

There has been a rapid decline in the spatial distribution of prairies (grassland habitat) throughout the range of the Taylor's checkerspot butterfly; as a result, the present distribution of Taylor's checkerspot butterfly is disjunct and isolated throughout the subspecies' historical range. If the Taylor's checkerspot butterfly is to recover, there must be sufficient suitable habitat available for population expansion and growth that is potentially connected in such a way as to allow for dispersal, and these sites must receive routine and sustained management to maintain the early seral conditions essential to the conservation of the subspecies.

All areas designated as critical habitat will require some level of management to address the current and future threats to the Taylor’s checkerspot butterfly to maintain or restore the PCEs. Threats to the physical or biological features that are essential to the conservation of the Taylor’s checkerspot butterfly include, but are not limited to: (1) Loss of habitat from conversion to other uses; (2) control of nonnative, invasive species; (3) development; (4) construction and maintenance of roads and utility corridors; and (5) habitat modifications brought on by succession of vegetation from the lack of disturbance, both small and large scale. These threats also have the potential to affect the PCEs if they occur within or adjacent to designated units.

Critical habitat for Taylor’s checkerspot butterfly requires special management to improve the viability and distribution of habitat suitable for the subspecies. These include preventing the establishment of invasive, nonnative and native woody species, and hastening restoration by actively managing sites to establish native plant species and the structure of the plant community that is suitable for the Taylor’s checkerspot butterfly. Restoration and maintenance of occupied Taylor’s checkerspot butterfly sites will require active management to plan, restore, enhance, and manage habitat using an approach that resets the vegetation composition and structure to an early seral stage. Management actions that maintain or restore the early seral conditions favored by the butterfly include prescribed fires, mechanical harvesting of trees, activities such as hand planting or mechanical planting of grasses and forbs, and the judicious use of herbicides for nonnative, invasive species control. These early-seral conditions favor the production and maintenance of plantain, paintbrush, and larval food plants in a short-structure vegetation community that allows utilization of the plants by the Taylor’s checkerspot butterfly. However, the timing of planned special management actions to maintain or improve habitat conditions is a key consideration, especially in areas occupied by the species. Activities that disturb soil or vegetation should not occur when the adult butterflies or the larvae are active, which extends from late February when post-diapause larvae are active to late June when pre-diapause larvae are on site. Even activities that occur during Taylor’s checkerspot butterfly diapause have the potential to kill larvae and should be limited in scope or otherwise minimized so that the species can persist on site while the habitat is receiving necessary management.